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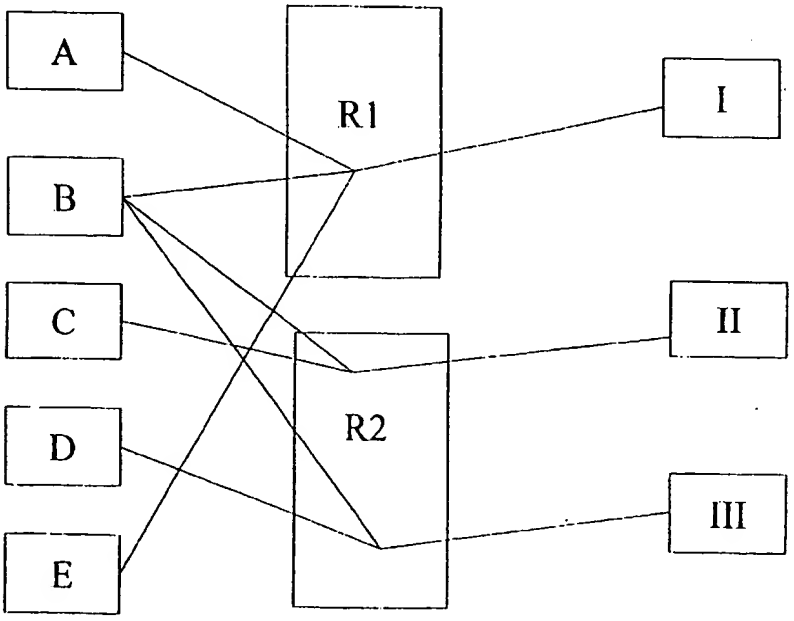
(54) Method of predicting and optimizing fuel production

(57) A process for the prediction and the optimization of the output of a plant producing products from incoming materials. The incoming materials are classified according to various physical characteristics and costs. The desired or ordered products arc also classified according to price and physical requirements. The incoming materials information and the product information is entered into a database which is accessible by a computing device. The computing device then calculates the optimal production process by calculating a plurality of production cycles and selecting the cycle with the optimum profitability. The computing device is programmed with non-linear equations derived from a regressive analysis of data collected from samples of incoming materials and products.

Figure 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates generally to a process and method for the prediction of the properties of and the optimization of a plant's output of products from a source or sources of raw material.

[0002] More specifically, the present invention relates to a process and method for increasing the predictability and profitability of operations where a series of raw materials are combined and processed into intermediate or final products by optimizing the cost structure of the raw materials, and the output of final or intermediate products to result in the lowest cost materials input and highest value production output.

[0003] The present invention also relates to the optimization of refining processes and petroleum blending operation to result in the highest value production output from available fuel stocks.

[0004] The present invention also relates to the accurate prediction of final properties of a blended fuel utilizing non-linear optimization and property prediction.

Description of the Prior Art

Fuel Additive Industry

[0005] It is well known in the petroleum and other industries to maximize profitability by blending fuel stocks with appropriate additives to increase their commercial value. Ethyl Corporation, of Richmond Virginia supplies many fuel additives, including a diesel cetane improver known commercially as DII-3™ which is used to raise the cetane level of a diesel fuel stock and thereby make otherwise lower-valued fuel stocks into valuable commercial fuels. MMT (manganese methylcyclopentadienyl manganese tricarbonyl) is a fuel additive, also manufactured by Ethyl Corporation, of Richmond Virginia, that provides octane enhancement while reducing the amount of crude oil necessary to produce gasoline. Ethyl Corporation additionally manufactures the HiTEC® 4700 Series of antioxidants, including hindered phenolics and diphenylamines to JP8+100 jet fuel additive which have known effects on the fuel.

[0006] Performance fuels for varied applications and engine requirements are known for controlling combustion chamber and intake valve deposits, cleaning port fuel injectors and carburetors, protecting against wear and oxidation, improving lubricity and emissions performance, and ensuring storage stability and cold weather flow.

[0007] Fuel detergents, dispersants, corrosion inhibitors, stabilizers, oxidation preventers, and performance additives are known to increase desirable properties of fuels.

[0008] It is known that mixtures of fuels and additives can increase and decrease desired properties in a resultant fuel blend.

SUMMARY OF THE INVENTION

[0009] The present invention contemplates supplying to an end user a tool for the prediction of and the consequent optimization of production from a plant which creates products from available raw materials.

[0010] The tool includes an update-able database of incoming raw material properties, preferably including physical properties as well as economic properties, e.g. the cost of those raw materials. The tool also includes a database of blendstock properties, product specifications, processes, and the market price for the final and/or end product. A user can input the available raw material stocks, including their costs and available volumes, and input the standing production orders, including price and minimum acceptable values, and the computing device will determine the accurate properties of the outcoming product and the optimum value to be extracted for a production run based on the available data.

[0011] In one embodiment, including by way of example diesel fuel stocks with cetane improver or pour point improvers, a method is disclosed utilizing linear and non linear equations to more accurately predict the cetane number, pour point, and/or other properties of the resulting fuel product.

[0012] In another embodiment, the present invention discloses a method of accurately predicting a characteristic of a product to be prepared by a processing plant, by providing an incoming material having at least one measured property, selecting at least one product having a desired characteristic to be prepared from said incoming material by said processing plant, selecting a process to be used by the processing plant to produce the product with its characteristic, and calculating a predicted value of the characteristic of the product utilizing a predictive equation. The predictive equation is a validated non-linear equation generated by regressive analysis of an accumulation of data relating the measured property of the incoming material, the process, and the characteristic of the product.

[0013] As used hereinbelow, "reactor" should be construed in its broadest sense, to include mixing vessels, distillation columns, thermal cracking devices, etc. which may admix, treat, react or otherwise affect a material therein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Figure 1 is a step block diagram of an exemplary production process.

DETAILED DESCRIPTION

Petroleum Generally

[0015] Crude oil, as a natural product, is very different in chemical composition depending upon the point of origin. Petroleum occurs throughout the world, and commercial fields have been located on every continent, crude oil from each region having very different properties. Petroleum is an extremely complex mixture and consists primarily of hydrocarbons as well as compounds containing nitrogen, oxygen, and sulfur. Most petroleums also contain minor amount of nickel and vanadium. Petroleums have a variety of different components with boiling ranges from about 20° C to above 650°C.

[0016] For an excellent discussion of the many and varied properties of crude oils, one may turn to, e.g. *Marks' Standard Handbook for Mechanical Engineers, Tenth Edition,*, T. Baumeister. McGraw Hill, 1996 (ISBN 0-07-004997-1), "Petroleum and Other Liquid Fuels", J.G. Speight, pp. 7-10 through 7-14, which are incorporated herein by reference.

[0017] The chemical and physical properties of petroleum vary considerably because of the variations in composition. Crude oils are rarely used as fuel because the properties do not meet the specifications required by either furnaces, boilers, or engines. Crude oils, being complex mixtures of various complex chemicals, are not predictably mixed as the properties do not blend linearly.

Refining Processes

[0018] Petroleum raw materials, e.g. crude oil from any of various sources in nature, are distilled into various fractions having differing commercial value.

[0019] Distillation separates the crude oil into fractions equivalent in boiling range to gasoline, kerosene, diesel fuel, lubricating oil, and residual. Thermal or catalytic cracking is used to convert kerosene, gas oil, or residual to gasoline, lower boiling fractions, and residual coke. Catalytic reforming, isomerization, alkylation, polymerization, hydrogenation. and combinations of these and other catalytic processes are used to upgrade the various refinery intermediates into improved gasoline stocks or distillates. The major finished products are usually blends of a number of stocks, plus additives.

[0020] Typical end products include gasoline, jet fuel, diesel fuel, residual products, specialty products, and petroleum coke.

[0021] Gasoline is a complex mixture of hydrocarbons that distills within the range of 100 to 400° F. Commercial gasolines are blends of straight-run, cracked, reformed, and natural gasolines.

[0022] The specifications for gasoline (ASTM D439 and D4814, which are incorporated herein by reference) provide for various volatility classes, varying from low-volatility gasolines to minimize vapor lock to high-volatility gasoline that permits easier starting during cold weather.

[0023] Aviation gasoline has a narrower boiling range than motor gasoline. It has fewer low boiling and high boiling components. Aviation gasoline is defined by ASTM D910.

[0024] Kerosene is less volatile than gasoline and has a higher flash point, to provide greater safety in handling. Other quality tests are specific gravity, color, odor, distillation range, sulfur content, and burning quality. Specific tests for quality include flash point (minimum 115°F), distillation endpoint (maximum 572°F) sulfur (maximum 0.13 percent) and color (minimum +16) according to ASTM D187.

[0025] Jet or Aviation turbine fuels are not limited by antiknock requirements and have wider boiling point ranges to assure greater availability for general aviation. Their properties are specified by ASTM D1655. Military requirements are as set forth in Military Specifications Mil-T-5624 (JP-4 and JP-5), Mil-T-83133 (JP-8), and Mil-P-87107 (JP-10).

[0026] Diesel fuel is a liquid product distilled over the range of 350° C to 650°F. The carbon number ranges from about C10 to C18. The chemical composition of a typical diesel fuel and how it applies to the individual specifications - API gravity, distillation range, pour point, and flash point - are directly attributable to both the carbon number and the compound classes present in the finished fuel.

[0027] Diesel fuels are measured in several aspects according to ASTM standards. They include API gravity (ASTM D1298), total sulfur (ASTM D2622), boiling point (ASTM D86), flash point (ASTM D93), pour point (ASTM D97), hydrogen content (ASTM D3701), cetane number (ASTM D613), acid number (ASTM D974), water and sediment content

(ASTM D1796), kinematic viscosity (ASTM D445), carbon residue on 10% residuum (ASTM D524), Ash (wt%) max (ASTM D482) and distillation temp (ASTM D86)

[0028] The various diesel fuels for motor use require variability in performance since the engines range in size from small, high speed engines used in trucks and buses, to large, low-speed stationary engines for power plants. Thus, ASTM D975 provides for the specifications of a variety of diesel fuels.

[0029] The combustion characteristics of diesel fuels are expressed in terms of the cetane number, a measure of ignition delay. A short delay (the time between injection and ignition) is desirable for a smooth running engine. Some diesel fuels contain cetane improvers, which usually are alkyl nitrates. The cetane number is determined by engine test (ASTM D613) or an approximate value, termed the cetane index, can be calculated for fuels which do not contain a cetane improver.

[0030] The value of each of these components fluctuates on a daily basis, depending on supply and demand, market factors such as political disturbance in oil-producing regions, and weather, among others. A lively futures market exists for various grades of crude oil and refined products. Keeping track of the cost of raw materials and prices of intermediate or finished products on a day-to-day basis is a daunting task.

[0031] Processing crude oil is an extraordinarily complicated matter. The oil refinery separates the crude oil into individual compounds, or, more often, distillation fractions that consist of compounds with similar properties.

Business Models and Solutions

[0032] Operating a refinery or fuel blending and distillation plant is extraordinarily complex. Operating one in the most profitable manner possible is likewise exponentially more difficult. Several treatises are available to help in the understanding of the petroleum industry and refining, such as Petroleum Refinery Process Economics, R.E. Maples, 1993, PennWell Publishing Company, Tulsa Oklahoma (ISBN 0-87814-384-X) and Petroleum Refining for the Non-technical Person, W.L. Leffler, 1979, 1985, PennWell Publishing Company, Tulsa Oklahoma (ISBN 0-87814-280-0), each of which is incorporated by reference.

[0033] Multiple software programs are available to assist in the economic running of a refinery. They include several commercially available from Aspen Tech, Cambridge, Massachusetts 02141-2200. Aspen PIMS™ is a PC-based linear programming software module used by the petroleum and petrochemical industries. The software is capable of handling detailed operations planning, economic evaluation and scheduling activities based upon the cost and availability of raw materials, capacity considerations, and the demand for output.

[0034] Aspen PIMS™ are a series of software tools for economic planning in the process industries. The system is designed to run on a Pentium™ class processor, or higher. Operating system platforms include Windows 95™, and Windows NT™.

[0035] Aspen PIMS™ employs a linear programming (LP) technique utilizing a CPLEX™ optimizer, available from ILOG CPLEX Division. Incline Village, NV 89451, to optimize the operation and design of refineries, petrochemical and chemical plants or other facilities. It is stated to be useful for such varies processes as evaluation of alternative feed-stocks and product slates, optimization of operating decisions and product blending, and sizing of plant units in grass-roots and expansion studies.

[0036] Aspen PIMS™ Scheduling Software assists in the preparation of detailed operating plans for material receipts, process operations, product blending and product shipments.

[0037] SDPIMS™, also available from Aspen Tech, is software which models complex multiple-source, multiple-product, multiple-mode, multiple-tiered pricing, multiple-destination supply and distribution sytems and develops an optimized, least-cost solution for the entire network. Among other items, the time value of money is taken into account, as are time period lags for product shipments, and minimum, maximum, and target inventories.

[0038] Aspen PIMS™ Refinery Scheduling System is software which is said to schedule refinery and petrochemical plant operations from feedstock arrivals to blendstock production, while Aspen PIMS™ Product Scheduling System is designed to schedule product blending and shipping activities. Aspen PIMS™ Pipeline Scheduling System is designed to schedule product deliveries through a pipeline network from product source through pumpstations and depots to final delivery point.

[0039] In terms of the underlying crude oil related products and their properties, PassMan™ also available from Aspen, is a PIMS™ crude oil assay manager whose function is to serve as a manager of a crude oil library and to output a table of crude oil data that is recut to the needs of the end user either for input into their linear production model or other applications. Other assay databases are available.

Optimization

[0040] Sunset Software Technology™, based in San Marino, California 91108, supplies multiple optimization algorithm based products. Sunset's products include linear, binary, mixed-integer, interior point (barrier) and quadratic

programming products and services, which operate on platforms ranging from PC's to UNIX workstations. They include products currently marketed under the following names: XA Linear Optimizer System™, XA Binary and Mixed Integer Solver™, XA Barrier Solver™, XA Quadratic Solver™, XA Parallel MIP Solver™, and XA Callable Library™.

[0041] CPLEX™ Base Development system, available from ILOG, includes several commercial optimizers - primal Simplex, dual Simplex, and network Simplex solvers for linear programming problems. This program is in one embodiment configured with the CPLEX Callable Library™, which provides CPLEX algorithms in a library of CPLEX algorithmic and utility routines. The CPLEX Mixed Integer Solver Option™ includes the capability to solve problems with mixed integer variables (general or binary), utilizing algorithms and techniques, including cuts (cliques & covers), heuristics, and a variety of branching and node selection strategies. CPLEX Barrier/QP Solver™ is a primal-dual log barrier algorithm with predictor corrector said to be useful for solving certain classes of linear programming models and quadratic programming problems.

[0042] AIMMS™ (Advanced Integrated Multidimensional Modeling Software), available from Paragon Decision Technology B.V., P.O. Box 3277, 2001 DG Haarlem, The Netherlands, is a software package which allows modelers to create functional analytic decision support applications. AIMMS contains a graphical model explorer, which builds and maintains complex (optimization-based) modeling applications. AIMMS is said to be capable of modeling a particular (optimization-based) decision support problem, creating an end-user interface around the model suitable for use by end users.

[0043] AMPL™ modeling language, available from CPLEX (a division of ILOG) is an algebraic modeling language for linear, nonlinear, and integer programming problems. It is said to be useful for optimization model types including linear programming problems, network problems, mixed integer programming problems, quadratic programming problems, and general non-linear programming problems.

[0044] The General Algebraic Modeling System (GAMS™), available from GAMS Development Corporation, 1217 Potomac Street NW, Washington, DC 20007 USA is software capable of modeling linear, nonlinear and mixed integer optimization problems. GAMS can solve LP, MIP and different forms of NLP models.

[0045] MPL™ (Mathematical Programming Language), available from Maximal Software, Inc., 2111 Wilson Boulevard, Suite 700, Arlington, VA 22201, U.S.A. is a modeling system that permits the construction of complex models, involving thousands of constraints which allows the import of data directly from a database and then export of the solution back into the database.

[0046] Models developed in MPL can be used with nearly all LP-solvers on the market today as MPL supports a number of industrial strength solvers.

[0047] The mathematical technique known as linear programming is commonly used by many of the above programs to solve a variety of industrial and scientific problems by arriving at an "optimal solution". Linear programming ("LP") has existed from about the 1940's. It works by creating an LP "model" which represents some situation that is then solved to discover the optimum plan.

[0048] A valid LP model must have four elements. First, there must be an objective function. Generally for business models the value to maximize is profit, and the value to be minimized is usually cost or distance. Each activity in the model contributes to this objective, either favorably or unfavorably. Second, there are limited resources. For example, a machine can only run for 24 hours in a day, or only so much material is available to purchase. Third, there must be linear relationships between activities and these resources. For example, one relationship might be the number of machine hours which should be operated and how much material should be bought. Finally, there must be an assumption of certainty, i.e. an assumption that these conditions in the model will be resolved feasibly. A more sophisticated technique known as stochastic programming exists to handle probability-based programming.

[0049] A variety of industrial LP applications have been developed to solve varying requirements. For example, in the field of product planning, one can plan an appropriate mix by solving the LP for optimal production quantities of products subject to resource capacity and market demand constraints. For blends, one can solve for optimal proportions of ingredients for products such as gasoline, foods, livestock feeds, subject to certain minimal requirements.

[0050] For distribution, one can use LP to solve for optimal shipping assignments from factories to distribution centers or from warehouses to retailers. For location planning, e.g. of facilities, one can determine the optimal location of a plant or warehouse with respect to total transportation costs between various alternative locations and existing supply and demand sources.

[0051] For process control, one can use LP models to, e.g.solve for the cutting pattern that minimizes the amount of scrap material, given the dimensions of a roll or sheet of raw material. For scheduling, one can use LP to determine the minimum-cost assignment of workers to shifts subject to varying demand. For vehicles, one can assign available vehicles to jobs and determine the number of trips to make, subject to vehicle size, availability, and demand constraints. Similarly, for routing, one can solve for the optimal routing of a product through a number of sequential processes, each with its own capacities and characteristics.

[0052] For production planning, one can solve for minimum-cost production scheduling for a given work force, taking into account inventory carrying and subcontracting costs. The management of production and work force may be

accomplished by LP by solving for minimum-cost production scheduling, taking into account hiring and layoff costs as well as inventory carrying, overtime, and subcontracting costs, subject to various capacity and policy constraints. Furthermore, one can solve for optimal staffing for various categories of workers, subject to various demand and policy constraints.

[0053] More sophisticated techniques involve the modification of standard LP techniques, but which relax some of the assumptions of the basic LP model.

[0054] Integer, binary, and mixed integer program modeling allow for activities that may only be conducted incrementally. With shipping for example, if one truckload is shipped, costs of the truck must be calculated whether one pallet or 24 pallets are shipped.

[0055] Non-linear programming allows for non-linear relationships between activities and constraints, while stochastic programming allows for uncertainty.

[0056] A presently preferred optimizer program for the instant invention is What'sBest!™ 4.0, available from Lindo Systems, Inc., 1415 North Dayton Street, Chicago, IL 60622, USA, which is an add-in to Excel™ (available from Microsoft, Inc. Redwood, WA) that allows the building of large scale optimization models in a free form layout within a spreadsheet. What'sBest!™ combines the linear, nonlinear and integer optimization with Microsoft™ Excel™.

Optimization in the Petroleum Industry

[0057] As noted above, there are many uses for various petroleum products, and each end use, e.g of diesel fuel has varying requirements for the product for safe, environmentally conscious, and economical use.

[0058] However, the fuel stocks on hand may frequently be limited to nonoptimal fuel stocks. For example, the refiner may need to determine whether it is more economical to blend a distillate component, such as Light Cycle Oil, into diesel or into residual product. Each of the fuels has a different value, and each of the raw materials (diesel fuel stocks, residual stocks, cetane improvers, etc) has a different value as a blending component.

[0059] The traditional approach has included mixing stocks in a blending operation to attempt to solve supply issues, but the accurate prediction of non-linear properties combined with a maximization of profit potential has been limited by the linear nature of the optimization software. There has been until now no validated way to accurately predict the properties of complex systems, e.g. blended fuels, additive enhanced fuels, and the like. In production, refiners are frequently forced to remeasure the data and compare it to a predicted value, making production decisions based upon these predicted properties delayed and/or flawed.

[0060] In one embodiment of the present invention, a complex production process can be more effectively managed from a business standpoint by assessing the relative values of incoming materials or components of the final product, and accurately predicting the properties of the final products.

[0061] Turning to Figure 1, a hypothetical production scenario is represented by the step block diagram. Various raw material sources, each having different properties, are labeled A, B, C, D and E. Production reactors R1 and R2 are available for the mixing or other processing of the raw materials. Desired end or final products are I, II and III.

[0062] Raw materials A-E may be virtually any raw material - crude oils for distillation, gasoline stocks for blending, additives and fuels for specialty fuel production, sands (e.g. silica) for raw glass or ceramic production, paint pigments and solvents for paint systems, particulates for alloy manufacture by tape casting, die casting, sintering, annealing, grains for cereal or bread production, nutraceuticals for vitamin manufacture, etc. The raw materials may be combinable by mixing, reacting, or otherwise commingling; or may be separatable by fractionation, distilling, cracking, or the like.

[0063] Each applicable industry to which this invention may be applied will have its own known methods of mixing, producing, refining, etc., which result in known products. The following examples, while most exemplary of the invention in the petroleum blending and additive industry, should not be construed as limiting, as the invention has far-ranging uses which one skilled in the art, having regard for this disclosure, will easily be able to achieve.

[0064] Fuels are blended differently for seasons and uses, as illustrated above. There are several different categories of blendstocks available for fuel use - aviation, kerosene, gasoline, diesel, and residual are the most common.

[0065] The blending of fuels is not represented by a linear relationship. Given the complex nature of the various petrochemicals present in fuelstocks, simply mixing a fuel component of a known cetane number, for example, with another of known cetane number does not necessarily result in an intermediate cetane number fuel. It is possible for a blended fuel to have a lower cetane number than either of the component diesel fuels, resulting in a loss in value (negative blending). Thus, it is vital to the economic survival of the refiner or manufacturer to have an accurate prediction of the properties and values of the resulting product.

[0066] By way of nonlimiting example, one possible manufacturing operation is the creation of a diesel fuel, by blending fuel streams and/or by the inclusion of a cetane improver. The standard method to measure the cetane number is the use of a cetane engine as described in ASTM D613. It is possible presently to predict cetane number with the cetane index equations indicated in ASTM D976 and ASTM D4737. However, such cetane index prediction models generally have an error of at least 2 cetane numbers. This is a costly error which can result in "cetane giveaway". Not

only is cetane index a poor predictor, it does not take into account the improvement in cetane number caused by additives.

[0067] Thus, if a pipeline has a requirement of a cetane number of 40, the cetane index must be at least 42 to assure the minimal requirements of the pipeline are being met. Table I, below indicates the cetane standards for the Colonial Pipeline Company, of Atlanta, Georgia.

TABLE I

Colonial Pipeline Company Specifications for Fungible Low Sulfur Diesel Fuel (cetane only) Issue No. 3; Grade 74					
	ASTM Test	Test Results			
PRODUCT PROPERTY	Method	Min	Max	Notes	
Notes					
Cetane Number	D613		40		
Cetane Index	D976		42		4
NOTES					

(4) Where cetane number by test method D613 is not available, test method D976 or D4737 can be used as an approximation. Minimum cetane index of 42 accounts for +/- 2 accuracy of the cetane index methods in approximating cetane number.

[0068] As may be seen from the above, one supplying fuel to the Colonial Pipeline using the standard Cetane Index calculation must supply fuel of a minimum of 42 cetane index, in effect giving away the commercial value of 38, and potentially 42 cetane number diesel fuel. Cetane Number must be determined using a Cetane Engine after the blend has been formulated and prepared, which is often too late to be of substantial economic advantage during preparation and blending.

[0069] However, with the novel invention, sufficient data is collected on a wide range of properties relating to a plurality of fuel components such that an extremely accurate prediction of the cetane number may be made.

[0070] Accurate prediction of the properties of the resultant product is important to assist in optimizing the output of a plant which produces such products; for example, the operator of such a plant may make more of a higher priced product than a lower priced product and thereby maximize profit, so long as the operator is assured that the final product will meet specifications. By means of this invention, additional components or reblending after formulation is not needed.

[0071] Ladommatos and Goacher in "Equations for predicting the cetane number of diesel fuels from their physical properties", *Fuel,* Vol. 74 No. 7, pp. 1083-1093 (1995) derived twenty-two equations for predicting the cetane number of diesel fuels. Likewise, Maxwell et all in "How to accurately predict cetane numbers of diesel-fuel blend stocks", *Oil and Gas Journal,* November 3, 1969 developed predictive equations for cetane value. These articles are incorporated by reference as if fully set forth herein.

[0072] Each of these articles, however, fails to provide a reliable prediction of the variety of properties required by a complex system of physical parameters. They rely primarily upon the cetane index, which alone is notoriously inaccurate.

[0073] An exemplary prediction of the cetane number of diesel fuel containing additives will be discussed as follows.

[0074] Turning now to Table II, several diesel fuel properties are indicated which are important for meeting the various ASTM or military specifications for such fuels (see, e.g. ASTM D975).

TABLE II -

DIESEL FUEL PHYSICAL PROPERTIES

Hydrocarbon Type

Carbon content

Hydrogen content

Sulfur content

Nitrogen content

TABLE II - (continued)

DIESEL FUEL PHYSICAL PROPERTIES

API (specific) gravity
Distillation range
Cetane number
Aniline point
Heat content
Kinematic viscosity
Cloud point
Pour point
Flash point

[0075] Data were collected on 154 low sulfur diesel fuels to derive cetane-prediction equations for diesel fuels with and without the addition of a cetane improver. The equations were derived by the use of statistical analysis including multiple linear regression to derive equations to predict the cetane number of fuels not in the original data set Equations containing different combinations of variables were developed to accommodate laboratories with different analytical capabilities. The invention thus provides prediction models using from 4 to 8 or more input variables.

[0076] The equations were then validated with twenty new fuels not in the original data set of 154 fuels.

[0077] The equations derived are a set of non-linear calculations as follows:

Definitions:

CN = cetane number (ASTM D613)
CN 0, 1000, 2500, 5000, 7500, 10000 = cetane number with ppmv of cetane improver DII-3™
T90= temperature at which 90% of the material boiled off (°C)
T50= temperature at which 50% of the material boiled off (°C)
T10= temperature at which 10% of the material boiled off (°C)
ANPT = aniline point (°C)
VISC40 = viscosity at 40° C (ASTM D445)
D976 = cetane index as provided by ASTM D976
CLOUD = temperature at which wax crystallization occurs (°C)
SPGR = specific gravity (no dimension)
FIAAROM = aromatic content (vol. %) measured by ASTM D1319

[0078] The exemplary preferred models for diesel fuel cetane number prediction upon inclusion of a cetane improver follow:

MODEL I (wherein there are 5 inputs)

[0079]

$$CN\ 0 = T90 \times (-0.073074) + ANPT \times 0.307979 + VISC40 \times (-1.152177) + D976 \times 0.49566 + CLOUD \times 0.183557 + 31.572661$$

$$CN\ 1000 = T90 \times (-0.093739) + ANPT \times 0.273761 + VISC40 \times (-0.951212) + D976 \times 0.588985 + CLOUD \times 0.206887 + 40.162203$$

$$CN\ 2500 = T90 \times (-0.096809) + ANPT \times 0.252126 + VISC40 \times (-0.988991) + D976 \times 0.670028 + CLOUD \times 0.194338 + 42.384571$$

CN 5000 = T90 x (-0.090088) + ANPT x 0.308413 + VISC40 x (-1.183015) + D976 x 0.646113 + CLOUD x 0.16953 + 41.297981

CN 7500 = T90 x (-0.076015) + ANPT x 0.362383 + VISC40 x (-1.306567) + D976 x 0.649497 + CLOUD x 0.137109 + 35.771915

CN 10000 = T90 x (-0.069705) + ANPT x 0.418994 + VISC40 x (-1.257463) + D976 x 0.603263 + CLOUD x 0.108566 + 33.746498

MODEL 2(5 inputs)

[0080]

CN0 = T50 x 0.170022 + T90 x (-0.090224) + SPGR x (-238.35652) + FIIAROM x (-0.119872) + CLOUD x 0.218696 + 237.776061

CN1000 = T50 x 0.180185 + T90 x (-0.106238) + SPGR x (-256.07975) + FIIAROM x (-0.112265) + CLOUD x 0.241931 + 259.828051

CN2500 = T50 x 0.186051 + T90 x (-0.107282) + SPGR x (-264.7448) + FIIAROM x (-0.121278) + CLOUD x 0.230962 + 269.911717

CN5000 = T50 x 0.192809 + T90 x (-0.103698) + SPGR x (-267.85828) + FIIAROM x (-0.148856) + CLOUD x 0.211281 + 273.437865

CN7500 = T50 x 0.207947 + T90 x (-0.092333) + SPGR x (-283.78141) + FIIAROM x (-0.169967) + CLOUD x 0.18288 + 282.147518

CN10000 = T50 x 0.216317 + T90 x (-0.086368) + SPGR x (-285.49607) + FIIAROM x (-0.193056) + CLOUD x 0.157395 + 281.674744

MODEL 3 (5 inputs)

[0081]

CN0 = T10 x 0.052862 + T50 x 0.132853 + T90 x (-0.073079) + SPGR x (-319.241664) + CLOUD x 0.198433 + 295.090575

$$CN1000 = T10 \times 0.055293 + T50 \times 0.139078 + T90 \times (-0.087318) + SPGR \times (-332.515775) + CLOUD \times 0.221971 + 313.561752$$

$$CN2500 = T10 \times 0.065233 + T50 \times 0.135657 + T90 \times (-0.084119) + SPGR \times (-347.966881) + CLOUD \times 0.208466 + 328.012419$$

$$CN5000 = T10 \times 0.091782 + T50 \times 0.118204 + T90 \times (-0.06947) + SPGR \times (-371.389545) + CLOUD \times 0.18161 + 344.864624$$

$$CN7500 = T10 \times 0.120328 + T50 \times 0.105859 + T90 \times (-0.045566) + SPGR \times (-403.830741) + CLOUD \times 0.146444 + 363.855067$$

$$CN10000 = T10 \times 0.137699 + T50 \times 0.099245 + T90 \times (-0.03274) + SPGR \times (-421.974629) + CLOUD \times 0.115835 + 374.491796$$

MODEL 4 (3 Inputs)

[0082]

$$CN0 = ANPT \times 0.281122 + VISC40 \times (-1.030139) + D976 \times 0.65189$$

$$CN1000 = ANPT \times 0.240331 + VISC40 \times (-0.909077) + D976 \times 0.794587$$

$$CN2500 = ANPT \times 0.217108 + VISC40 \times (-1.074988) + D976 \times 0.914676$$

$$CN5000 = ANPT \times 0.263156 + VISC40 \times (-1.335108) + D976 \times 0.936531$$

$$CN7500 = ANPT \times 0.304818 + VISC40 \times (-1.322044) + D976 \times 0.934638$$

$$CN10000 = ANPT \times 0.3534 + VISC40 \times (-1.25902) + D976 \times 0.905473$$

MODEL 5 (7 inputs)

[0083]

$$CN0 = T10 \times -0.565869 + T50 \times T90 \times 0.000458 + (T90)^2 \times (-0.000992) + T10/SPGR \times 0.526071 + T90/SPGR \times 0.426314 - 64.399604$$

$$CN1000 = T10 \times -0.443266 + T50 \times T90 \times 0.000483 + (T90)^2 \times (-0.001215) + T10/SPGR$$

x 0.425422 + T90/SPGR x 0.536406 - 81.532783

$$CN2500 = T10 \times -0.473346 + T50 \times T90 \times 0.000468 + (T90)^2 \times (-0.001226) + T10/SPGR \times 0.458768 + T90/SPGR \times 0.542029 - 79.539029$$

$$CN5000 = T10 \times -0.582345 - T50 \times T90 \times 0.000399 + (T90)^2 \times (-0.00113) + T10/SPGR \times 0.573578 + T90/SPGR \times 0.50863 - 73.521591$$

$$CN7500 = T10 \times -0.624713 + T50 \times T90 \times 0.000359 + (T90)^2 \times (-0.001125) + T10/SPGR \times 0.632041 + T90/SPGR \times 0.524471 - 79.914841$$

$$CN10000 = T10 \times -0.722336 + T50 \times T90 \times 0.000346 + (T90)^2 \times (-0.001046) + T10/SPGR \times 0.727228 + T90/SPGR \times 0.487577 - 74.343479$$

[0084] Cetane numbers at intermediate concentrations of cetane improver are calculated by interpolating the values from these formulae. The formulae may be reduced to lower numbers of significant figures, e.g. 2, 3, or 4 with minimal loss of accuracy of prediction.

[0085] This method allows the calculation of cetane numbers of the product from the properties of the components, and does not rely on the cetanes. As discussed infra, many of the ingredients in a complex chemical system react in a nonlinear fashion and result in unexpected properties. Accumulation of data and the subsequent inclusion of corrections in a nonlinear model enables the inventive method to provide a far more accurate prediction of the properties of the resultant composition or system.

[0086] The formulas which follow, containing fewer significant digits, also provide the benefits of the instant invention

Model 1

[0087]

$$CN0 = -0.07307 \times T10 + 0.3080 \times ANPT - 1.152 \times VISC40 + 0.4957 \times D976 + 0.1836 \times CLOUD + 31.57$$

$$CN1000 = -0.09374 \times T10 + 0.2738 \times ANPT - 0.9512 \times VISC40 + 0.5890 \times D976 + 0.2069 \times CLOUD + 40.16$$

$$CN2500 = -0.09681 \times T10 + 0.2521 \times ANPT - 0.9890 \times VISC40 + 0.6700 \times D976 + 0.1943 \times CLOUD + 42.38$$

$$CN5000 = -0.09009 \times T10 + 0.3084 \times ANPT - 1.183 \times VISC40 + 0.6461 \times D976 + 0.1695 \times CLOUD + 41.30$$

$$CN7500 = -0.07602 \times T10 + 0.3624 \times ANPT - 1.307 \times VISC40 + 0.6495 \times D976 + 0.1371 \times CLOUD + 35.77$$

$$CN10000 = -0.06971 \times T10 + 0.4190 \times ANPT - 1.257 \times VISC40 + 0.6033 \times D976 + 0.1086 \times CLOUD + 33.75$$

[0088] A generic formula is also provided which is suitable for the practice of the instant invention:

$$CN(X) = T10 \times (-0.06971 \text{ to } -0.09681) + ANPT \times (0.2521 \text{ to } 0.4190) + VISC40 \times (-0.9512 \text{ to } -1.307) + D976 \times (0.4957 \text{ to } 0.6700) + CLOUD \times (0.1086 \text{ to } 0.2069) + (31.57 \text{ to } 42.38),$$

where (X) equals ppmv of cetane improver.

Model 2

[0089]

$$CN0 = 0.1700 \times T50 - 0.09022 \times T90 - 238.4 \times SPGR - 0.1199 \times FIAAROM + 0.2187 \times CLOUD + 237.8$$

$$CN1000 = 0.1802 \times T50 - 0.1062 \times T90 - 256.1 \times SPGR - 0.1123 \times FIAAROM + 0.2419 \times CLOUD + 259.8$$

$$CN2500 = 0.1861 \times T50 - 0.1073 \times T90 - 264.7 \times SPGR - 0.1213 \times FIAAROM + 0.2310 \times CLOUD + 269.9$$

$$CN5000 = 0.1928 \times T50 - 0.1037 \times T90 - 267.9 \times SPGR - 0.1489 \times FIAAROM + 0.2113 \times CLOUD + 273.4$$

$$CN7500 = 0.2079 \times T50 - 0.09233 \times T90 - 283.8 \times SPGR - 0.1700 \times FIAAROM + 0.1829 \times CLOUD + 282.1$$

$$CN10000 = 0.2163 \times T50 - 0.08637 \times T90 - 285.5 \times SPGR - 0.1931 \times FIAAROM + 0.1574 \times CLOUD + 281.7$$

[0090] A generic formula is also provided which is suitable for the practice of the instant invention:

$$CN(X) = T50 \times (0.1700 \text{ to } 0.2163) + T90 \times (-0.08637 \text{ to } -0.1073) + SPGR \times (-238.4$$

to -285.5) + FIAAROM x (-0.1123 to -0.1931) + CLOUD x (0.1574 to 0.2419) +(237.8 to 282.1),

where (X) equals ppmv of cetane improver.

Model 3

[0091]

$$CN0 = 0.05286 \times T10 + 0.1329 \times T50 - 0.07308 \times T90 - 319.2 \times SPGR + 0.1984 \times CLOUD + 295.1$$

$$CN1000 = 0.05529 \times T10 + 0.1391 \times T50 - 0.08732 \times T90 -- 332.5 \times SPGR + 0.2220 \times CLOUD + 313.6$$

$$CN2500 = 0.06523 \times T10 + 0.1357 \times T50 - 0.08412 \times T90 - 348.0 \times SPGR + 0.2085 \times CLOUD + 328.0$$

$$CN5000 = 0.09178 \times T10 + 0.1182 \times T50 - 0.06947 \times T90 - 371.4 \times SPGR + 0.1817 \times CLOUD + 344.9$$

$$CN7500 = 0.1203 \times T10 + 0.1059 \times T50 - 0.04557 \times T90 - 403.8 \times SPGR + 0.1464 \times CLOUD + 363.9$$

$$CN1000 = 0.1377 \times T10 + 0.09925 \times T50 - 0.03274 \times T90 - 422.0 \times SPGR + 0.1158 \times CLOUD + 374.5$$

[0092] A generic formula is also provided which is suitable for the practice of the instant invention:

CN(X) = T10 x (0.05286 to 0.1377) + T50 x (0.09925 to 0.1391) + T90 (-0.03274 to -0.08732) + SPGR x (-319.2 to -422.0) + CLOUD x (0.1158 to 0.2220) + (295.1 to 374.5),

where (X) equals ppmv of cetane improver.

Model 4

[0093]

$$CN0 = 0.2811 \times ANPT - 1.030 \times VISC40 + 0.6519 \times D976$$

$$CN1000 = 0.2403 \times ANPT - 0.9091 \times VISC40 + 0.7946 \times D976$$

$$CN2500 = 0.2171 \times ANPT - 1.075 \times VISC40 + 0.9147 \times D976$$

$$CN5000 = 0.2632 \times ANPT - 1.335 \times VISC40 + 0.9365 \times D976$$

$$CN7500 = 0.3048 \times ANPT - 1.322 \times VISC40 + 0.9346 \times D976$$

$$CN10000 = 0.3534 \times ANPT - 1.259 \times VISC40 + 0.9055 \times D976$$

[0094] A generic formula is also provided which is suitable for the practice of the instant invention:

$$CN(X) = ANPT \times (0.2171 \text{ to } 0.3534) + VISC40 \ (-0.9091 \text{ to } -1.335) + D976 \times (0.6519 \text{ to } 0.9365),$$

where (X) equals ppmv of cetane improver.

Model 5

[0095]

$$CN0 = -0.5659 \times T10 + 0.000458 \times T50 \times T90 - 0.000992 \times (T90)^2 + 0.5261 \times T10/SPGR + 0.4263 \times T90/SPGR - 64.40$$

$$CN1000 = -0.4433 \times T10 + 0.000483 \times T50 \times T90 - 0.001215 \times (T90)^2 + 0.4254 \times T10/SPGR + 0.5364 \times T90/SPGR - 81.53$$

$$CN2500 = -0.4733 \times T10 + 0.000468 \times T50 \times T90 - 0.001226 \times (T90)^2 + 0.4588 \times T10/SPGR + 0.5420 \times T90/SPGR - 79.54$$

$$CN5000 = -0.5823 \times T10 + 0.000399 \times T50 \times T90 - 0.001130 \times (T90)^2 + 0.5736 \times T10/SPGR + 0.5086 \times T90/SPGR - 73.52$$

$$CN7500 = -0.6247 \times T10 + 0.000359 \times T50 \times T90 - 0.001125 \times (T90)^2 + 0.6320 \times T10/SPGR + 0.5245 \times T90/SPGR - 79.91$$

$$CN10000 = -0.7223 \times T10 + 0.000346 \times T50 \times T90 - 0.001046 \times (T90)^2 + 0.7272 \times T10/SPGR + 0.4876 \times T90/SPGR - 74.34$$

[0096] A generic formula is also provided which is suitable for the practice of the instant invention:

$$CN(X) = T10 \times (-0.4433 \text{ to } -0.7223) + T50 \times T90 \times (0.000346 \text{ to } 0.000483) + (T90)^2 \times$$

(-0.000992 to -0.001226) + T10/SPGR x (0.4254 to 0.7272) + T90/SPGR x (0.4263 to 0.5420) + (-64.40 to -81.53),

where (X) equals ppmv of cetane improver.

[0097] Turning now to Table III below, a comparison of the values of the cetane number of 20 fuels, calculated by the prior art methods (D-976, D-4737, and CGSB (Canadian General Standards Bureau method) versus the instant models is illustrated.

TABLE III

Fuel	CN	D-976	D-4737	CGSB	Model 1	Model 2	Model 3	Model 4	Model 5
A	48.5	49.8	51.6	50.1	48.1	46.9	48.4	48.3	48.7
B	47.8	48.2	48.0	46.5	45.7	45.1	45.2	46.4	46.0
C	41.2	43.7	43.1	40.7	41.3	41.4	41.3	41.1	41.2
D	45.0	47.0	47.4	41.0	43.8	46.8	46.1	43.7	45.9
E	43.5	46.1	45.7	44.5	44.0	43.5	43.4	44.7	44.6
F	44.9	45.2	45.2	44.4	45.2	45.4	45.0	44.4	44.5
G	42.1	48.2	48.0	46.4	46.2	46.0	45.6	46.6	46.0
H	47.6	51.7	52.9	52.6	51.6	50.9	51.0	51.2	50.8
I	40.2	42.0	40.7	38.7	40.2	40.2	39.7	39.3	39.0
J	43.2	43.4	42.4	40.4	41.9	42.1	41.5	41.0	40.7
K	51.7	55.8	55.7	52.8	53.1	53.3	52.3	53.9	52.6
L	43.6	46.8	47.0	43.7	44.7	45.1	45.2	44.7	45.4
M	37.0	41.5	40.9	40.7	37.7	37.3	36.8	39.6	39.3
N	46.0	47.0	47.1	44.0	44.5	44.7	44.9	44.8	45.4
O	47.9	50.7	51.4	49.2	48.1	48.4	48.2	48.7	48.7
P	43.4	45.2	45.4	44.2	45.2	45.8	45.0	44.3	44.5
Q	49.0	49.6	50.4	49.6	47.8	47.8	47.3	48.4	48.0
R	52.6	52.2	54.1	53.2	48.2	48.1	48.0	50.9	50.9
S	40.8	42.2	41.3	42.0	40.0	39.1	38.9	41.0	40.6
T	47.2	48.5	48.2	45.8	46.2	45.6	46.0	46.6	46.5
RMSE		2.6	2.8	2.3	1.9	2.0	1.9	1.8	1.6

[0098] It is clearly seen that the root mean square error (RMSE) of the inventive method is significantly below that of any of the prior art methods for predicting the cetane number of diesel fuel with a cetane improver therein.

[0099] In a preferred embodiment of the present invention, there are at least 8 component properties which are collected from actual samples, and resulting blended products. The properties are then entered into a database or spreadsheet and correlated to cetane number by linear regression analysis. In another preferred embodiment, there are at least 4 (four) properties measured for each component used in the final blend. Five, six, seven, or more properties are also acceptable, and there may be as many as required to formulate a statistically proper prediction equation.

[0100] Preferably, the prediction calculation is tied into a spreadsheet, such as Excel™, even more preferably along with additional calculations such as cost.

Initially, the product to be produced, and its characteristics are selected. Such characteristics include typically such qualities as minimum and maximum volumes, price of the end product, minimum and maximum API, maximum sulfur content, minimum flash point, maximum aromatics content, maximum freeze point, T90, cloud point, pour point, viscosity at 100 degrees C (ASTM D445), viscosity at 40 degrees C, vanadium content, and cetane number.

[0101] Then, the appropriate feedstock to create the desired product is provided to the model. Characteristics of the feedstock to be selected for fuel production include amount available, purchase price, API, sulfur content, aromatics, naphthalene content, smoke, vanadium content, aniline point, cloud point, flash point, freeze point, pour point, viscosity at 100°C, viscosity at 40°C, distillation T10, distillation T50, distillation T90, and cetane number.

[0102] Then, the product requirements and raw materials data are inputted into the database either manually or by importation from another database in a known manner. Table IV illustrates an exemplary entry table for cetane requirements for a finished product.

TABLE IV -

Cetane Specification Input Table for Diesel Fuel					
CETANE					
CALCULATIONS					
		Data Required:			
Method 1	Ethyl	API, T50,	T90,	AnPt, Visc.,	Cloud
Method 2	Ethyl	API, T50,	T90,		Cloud, Arom
Method 3	Ethyl	API, T50, T10,	T90,		Cloud
Method 4	Ethyl	API, T50,		AnPt, Visc.	
Method 5	Ethyl	API, T50, T10,	T90		
ASTM Method	D-976	API, T50			

[0103] Depending on the data available, the appropriate method for calculating the required input ingredients is selected. Methods 1-5 are according to the present invention for calculating cetane requirements, the ASTM method D-976 is according to the prior art. It is notable that D-976 requires only two inputs. API gravity and T50.

[0104] If additional requirements are desired, they may be inputted via a similar spreadsheet table. Any other desired information, including processing information, costs, times, volumes, etc. may be included. An additionally preferred embodiment includes calculations for cold flow improver for diesel fuel once the variables have been calculated utilizing the multiple regression analysis of the instant invention.

[0105] Once the product characteristics have been inputted, a computing device (preferably a Pentium based PC running a form of Windows or equivalent software) then may calculate the required feedstock to manufacture the product. The calculations may be run in reverse, i.e. to determine what may be produced from the feedstock on hand.

[0106] Furthermore, the instant invention allows for the "tuning" of the equations for particular refineries, fuel sources, geographical variances, etc. with the collection of additional data and verification through actual samples. Each of the variables may be adjusted by one of skill in the art having regard for this disclosure by regressive analysis or similar means.

[0107] The efficient and profitable operation of a large scale manufacturing facility is illustrated as follows. A target cetane number for fuel is selected for a particular application, e.g. 45.

[0108] The fuel may be made a number of ways, by mixing various components, and/or by adding a cetane improver to the blend. Turning to Table V. which follows, the following pricing information is assumed to be known (not actual amounts):

Low Sulfur Diesel market price $23.10 / bbl
Residual Fuel Oil market price $16.38/bbl
DII-3 market price $0.75/pound
Nominal refinery diesel output: 50,000 barrels per day (B/D)

[0109] The method according to the instant invention determines the precise amounts of components of the types of Virgin Distillate, Light Cycle Oil (LCO), and Cetane Improver to add to reach the desired property of 45 cetane number. However, profit optimization can help select the more economical production route, when ordinarily one such route might have been ignored. Case One is a traditional blend to result in the desired CN, and requires that a large amount of LCO be placed into the less profitable residual product. Whereas, in Case Two, the inclusion of DII-3™ cetane improver allows more LCO to be incorporated into the Diesel Pool, and less LCO into the less profitable Resid Pool. The sums saved are significant.

Table V

Product data:

Diesel price:	$23.10/bbl
Resid price:	$16.38/bbl
Target CN:	45

Case One, *low* usage rate of inexpensive componet LCO

Component	Bbl placed in Diesel pool	Diesel Rev, $	Bbl placed in Resid pool	Resid Rev, $	Total Rev, $
Virgin distillate	35,000	808,500	0	0	808,500
LCO	5,000	115,500	10,000	163,800	279,300
				Total Rev:	1,087,800

Case Two, *high* usage rate of inexpensive componet LCO

Component	Bbl placed in Diesel pool	Diesel Rev, $	Bbl placed in Resid pool	Resid Rev, $	Total Rev, $
Virgin distillate	34,950	807,345	0	0	807,345
LCO	9,950	229,845	5,000	81,900	311,745
DII-3	100	-25,295			-25,295
				Total Rev:	1,093,796

Results (comparing Case Two to Case One):

Savings per bbl:	$0.12
Savings per day:	$5,996
Savings per yr:	$2,188,358

[0110] The entire disclosure of all applications, patents, available software, ASTM and other standards, and publications cited above and throughout this application are hereby incorporated by reference.

[0111] The preceding examples can be repeated with similar success by substituting the generically or specifically described compositions, reactants and/or operating conditions of this invention for those used in the preceding examples.

[0112] From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this

invention and, without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions.

[0113] While the invention has been described in connection with the preferred embodiment, it should be understood readily that the present invention is not limited to the disclosed embodiment. Rather, the present invention is intended to cover various equivalent arrangements and is only limited by the claims which follow:

Claims

1. A method of predicting a characteristic of a product to be prepared by a processing plant, comprising:

   (a) identifying an incoming material, said material having at least one measured property;
   (b) selecting at least one product to be prepared from said incoming material by said processing plant, said product having at least one desired characteristic;
   (c) selecting a process to be used by the processing plant to produce the product, said process having an effect upon the characteristic of the product; and
   (d) calculating a predicted value of the characteristic of the product using a predictive equation,

   wherein the predictive equation is generated by regressive analysis of an accumulation of data relating to (i) the or each measured property of the incoming material, (ii) the process and (iii) the characteristic of the product.

2. A method according to claim 1, wherein the incoming material is a petroleum feedstock, the product is diesel fuel, the process is admixing cetane improver, and the characteristic of the product is cetane number.

3. A method according to claim 2, wherein the measured property is selected from hydrocarbon type, carbon content, hydrogen content, sulfur content, nitrogen content, API gravity, distillation range, cetane number, aniline point, heat content, kinematic viscosity, cloud point, pour point, and/or flash point.

4. A method according to claim 2, wherein the measured property includes at least API gravity, T50 and at least two additional properties selected from T10, T90, aniline point, viscosity, cloud point, and aromatics content.

5. A method according to claim 4, wherein either (a) the at least two additional properties are T90, aniline point, viscosity, and cloud point, (b) the at least two additional properties are T90, cloud point, and aromatics content, (c) the at least two additional properties are T10, T90, and cloud point, (d) the at least two additional properties are viscosity and aniline point or (e) the at least two additional properties are T10 and T90.

6. A method according to claim 5, wherein the at least two additional properties are T90, aniline point, viscosity and cloud point and the predictive equation is a set of non-linear equations comprising:

$$CN0 = -0.07307 \times T10 + 0.3080 \times ANPT - 1.152 \times VISC40 + 0.4957 \times D976 + 0.1836 \times CLOUD + 31.57$$

$$CN1000 = -0.09374 \times T10 + 0.2738 \times ANPT - 0.9512 \times VISC40 + 0.5890 \times D976 + 0.2069 \times CLOUD + 40.16$$

$$CN2500 = -0.09681 \times T10 + 0.2521 \times ANPT - 0.9890 \times VISC40 + 0.6700 \times D976 + 0.1943 \times CLOUD + 42.38$$

$$CN5000 = -0.09009 \times T10 + 0.3084 \times ANPT - 1.183 \times VISC40 + 0.6461 \times D976 + 0.1695 \times CLOUD + 41.30$$

$$CN7500 = -0.07602 \times T10 + 0.3624 \times ANPT - 1.307 \times VISC40 + 0.6495 \times D976 + 0.1371 \times CLOUD + 35.77$$

$$CN10000 = -0.06971 \times T10 + 0.4190 \times ANPT - 1.257 \times VISC40 + 0.6033 \times D976 + 0.1086 \times CLOUD + 33.75$$

wherein

CN is cetane number of the product at the noted concentration of cetane improver of from 0 to 10,000 ppmv, and intermediate values are interpolated between points,
T10 is the temperature at which 10% of the product boils off,
ANPT is the aniline point of the product,
VISC40 is the viscosity of the product at 40°C according to ASTM D445,
D976 is the cetane index of the product according to ASTM D976, and
CLOUD is the cloud point of the product.

7. A method according to claim 5, wherein the at least two additional properties are T90, cloud point and aromatics content and the predictive equation is a set of non-linear equations comprising:

$$CN0 = 0.1700 \times T50 - 0.09022 \times T90 - 238.4 \times SPGR - 0.1199 \times FIAAROM + 0.2187 \times CLOUD + 237.8$$

$$CN1000 = 0.1802 \times T50 - 0.1062 \times T90 - 256.1 \times SPGR - 0.1123 \times FIAAROM + 0.2419 \times CLOUD + 259.8$$

$$CN2500 = 0.1861 \times T50 - 0.1073 \times T90 - 264.7 \times SPGR - 0.1213 \times FIAAROM + 0.2310 \times CLOUD + 269.9$$

$$CN5000 = 0.1928 \times T50 - 0.1037 \times T90 - 267.9 \times SPGR - 0.1489 \times FIAAROM + 0.2113 \times CLOUD + 273.4$$

$$CN7500 = 0.2079 \times T50 - 0.09233 \times T90 - 283.8 \times SPGR - 0.1700 \times FIAAROM + 0.1829 \times CLOUD + 282.1$$

$$CN10000 = 0.2163 \times T50 - 0.08637 \times T90 - 285.5 \times SPGR - 0.1931 \times FIAAROM + 0.1574 \times CLOUD + 281.7$$

wherein

CN is cetane number of the product at the noted concentration of cetane improver of from 0 to 10,000 ppmv, and intermediate values are interpolated between points,
T50 is the temperature at which 50% of the product boils off,

T90 is the temperature at which 90% of the product boils off,
SPGR is the specific (API) gravity of the product,
FIAAROM is the aromatics content of the product according to ASTM D1319, and
CLOUD is the cloud point of the product.

8. A method according to claim 5, wherein the at least two additional properties are T10, T90 and cloud point and the predictive equation is a set of nonlinear equations comprising:

$$CN0 = 0.05286 \times T10 + 0.1329 \times T50 - 0.07308 \times T90 - 319.2 \times SPGR + 0.1984 \times CLOUD + 295.1$$

$$CN1000 = 0.05529 \times T10 + 0.1391 \times T50 - 0.08732 \times T90 - 332.5 \times SPGR + 0.2220 \times CLOUD + 313.6$$

$$CN2500 = 0.06523 \times T10 + 0.1357 \times T50 - 0.08412 \times T90 - 348.0 \times SPGR + 0.2085 \times CLOUD + 328.0$$

$$CN5000 = 0.09178 \times T10 + 0.1182 \times T50 - 0.06947 \times T90 - 371.4 \times SPGR + 0.1817 \times CLOUD + 344.9$$

$$CN7500 = 0.1203 \times T10 + 0.1059 \times T50 - 0.04557 \times T90 - 403.8 \times SPGR + 0.1464 \times CLOUD + 363.9$$

$$CN10000 = 0.1377 \times T10 + 0.09925 \times T50 - 0.03274 \times T90 - 422.0 \times SPGR + 0.1158 \times CLOUD + 374.5$$

wherein

CN is cetane number of the product at the noted concentration of cetane improver of from 0 to 10,000 ppmv, and intermediate values are interpolated between points,
T10 is the temperature at which 10% of the product boils off,
T50 is the temperature at which 50% of the product boils off,
T90 is the temperature at which 90% of the product boils off,
SPGR is the specific gravity of the product, and
CLOUD is the cloud point of the product.

9. A method according to claim 5, wherein the at least two additional properties are viscosity and aniline point and the predictive equation is a set of non-linear equations comprising:

$$CN0 = 0.2811 \times ANPT - 1.030 \times VISC40 + 0.6519 \times D976$$

$$CN1000 = 0.2403 \times ANPT - 0.9091 \times VISC40 + 0.7946 \times D976$$

$$CN2500 = 0.2171 \times ANPT - 1.075 \times VISC40 + 0.9147 \times D976$$

$$CN5000 = 0.2632 \times ANPT - 1.335 \times VISC40 + 0.9365 \times D976$$

$$CN7500 = 0.3048 \times ANPT - 1.322 \times VISC40 + 0.9346 \times D976$$

$$CN10000 = 0.3534 \times ANPT - 1.259 \times VISC40 + 0.9055 \times D976$$

wherein

CN is cetane number of the product at the noted concentration of cetane improver of from 0 to 10,000 ppmv, and intermediate values are interpolated between points,
ANPT is the aniline point of the product,
VISC40 is the viscosity of the product at 40°C according to ASTM D445, and
D976 is the cetane index of the product according to ASTM D976.

10. A method according to claim 5, wherein the at least two additional properties are T10 and T90 and the predictive equation is a set of non-linear equations comprising:

$$CN0 = -0.5659 \times T10 + 0.000458 \times T50 \times T90 - 0.000992 \times (T90)^2 + 0.5261 \times T10/SPGR + 0.4263 \times T90/SPGR - 64.40$$

$$CN1000 = -0.4433 \times T10 + 0.000483 \times T50 \times T90 - 0.001215 \times (T90)^2 + 0.4254 \times T10/SPGR + 0.5364 \times T90/SPGR - 81.53$$

$$CN2500 = -0.4733 \times T10 + 0.000468 \times T50 \times T90 - 0.001226 \times (T90)^2 + 0.4588 \times T10/SPGR + 0.5420 \times T90/SPGR - 79.54$$

$$CN5000 = -0.5823 \times T10 + 0.000399 \times T50 \times T90 - 0.001130 \times (T90)^2 + 0.5736 \times T10/SPGR + 0.5086 \times T90/SPGR - 73.52$$

$$CN7500 = -0.6247 \times T10 + 0.000359 \times T50 \times T90 - 0.001125 \times (T90)^2 + 0.6320 \times T10/SPGR + 0.5245 \times T90/SPGR - 79.91$$

$$CN10000 = -0.7223 \times T10 + 0.000346 \times T50 \times T90 - 0.001046 \times (T90)^2 + 0.7272 \times T10/SPGR + 0.4876 \times T90/SPGR - 74.34$$

wherein:

CN is cetane number of the product at the noted concentration of cetane improver of from 0 to 10,000 ppmv, and intermediate values are interpolated between points,
T10 is the temperature at which 10% of the product boils off,

T50 is the temperature at which 50% of the product boils off,
T90 is the temperature at which 90% of the product boils off, and
SPGR is the specific gravity of the product.

11. A method according to any one of the preceding claims, wherein the predictive equation is a set of non-linear equations derived by

- accumulating data relating the or each said characteristic of the product to (a) the or each measured property of the incoming material and (b) the effect of the process; and
- carrying out regressive analysis on the thus obtained data to correlate the said characteristic of the product to (a) and (b).

12. A method as claimed in claim 1, wherein the product is diesel fuel, and at least one characteristic of the product is pour point.

13. A method according to any one of the preceding claims, wherein step (d) is carried out on a computing device with appropriate software.

14. A method according to any one of the preceding claims, wherein the cost of the incoming material and the market price of the product are known, and step (d) includes optimizing the profitability of the process.

15. A method of manufacturing a product, comprising:

(i) predicting a characteristic of the product by a method according to any one of the preceding claims; and
(ii) manufacturing the product from the identified incoming material using the selected process.

16. A method according to claim 15, comprising the further steps, repeated as necessary prior to step (ii), of changing the selected process and repeating step (i), to optimise the said characteristic.

17. A computer program comprising computer program code means which, when executed on a computer, instruct the computer to carry out the steps of a method according to any one of the preceding claims.

18. A computer readable medium having recorded thereon a computer program according to claim 17.

19. A process for the value optimization of a plant which processes at least one incoming material and produces at least one product, comprising

(a) assessing at least one property of the or each incoming material;
(b) assessing the cost of the or each incoming material;
(c) inputting said property and cost of the or each incoming material into a database;
(d) determining at least one characteristic of the or each product;
(e) assessing the value of the or each product;
(f) inputting said at least one characteristic and the value of the or each product into a database; and
(g) calculating a value - optimized process for obtaining the or each product from the incoming material using a computing device accessing said database and calculating the cheapest way of producing the or each product, using a non-linear equation derived from regressive analysis of data from a history of properties of incoming materials, processes, and products.

20. A process according to claim 19, wherein the plant comprises a petroleum products blending plant.

21. A process according to claim 19 or 20, wherein there are a plurality of properties of the or each incoming material which are assessed.

22. A process according to claim 19, wherein there are a plurality of incoming materials and a plurality of products.

23. A process according to any one of claims 19 to 22, wherein step (a) includes gathering information in at least one category selected from hydrocarbon type, carbon content, hydrogen content, sulfur content, nitrogen content, API gravity, distillation range, cetane number, aniline point, heat content, kinematic viscosity, cloud point, pour point,

and flash point.

24. A process for the optimization of diesel fuel production, comprising

(a) providing at least one database of diesel fuel stocks, additives and products, having a set of known properties;
(b) providing a non-linear formula for the prediction of diesel fuel properties based upon a regressive analysis of the known properties collected from a series of samples;
(c) providing a computing device connected to said at least one database;
(d) providing computing instructions incorporating said formula for the prediction of diesel fuel properties; and
(e) calculating the diesel fuel properties utilizing said computing device.

25. A process according to claim 24, wherein the computing device is a computer and the instructions comprise computer software.

26. A process according to claim 24 or 25, wherein the database is a spreadsheet of the set of known properties.

27. A process according to any one of claims 24 to 26, wherein the database includes the price of the diesel fuel stocks, additives, and products and the cost of processing, and the software includes an optimizer, whereby the maximum profitability of the process may be calculated.

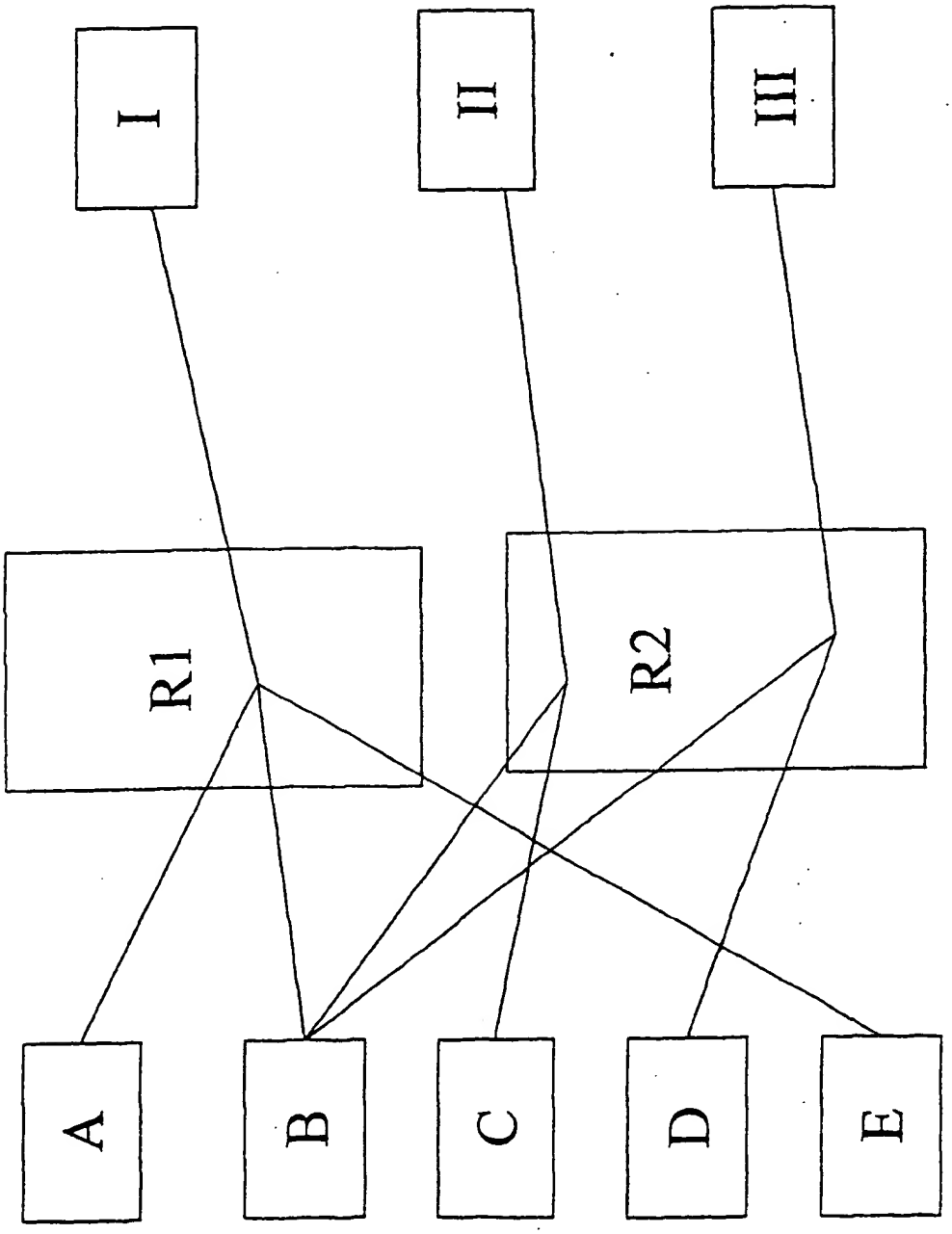
28. A method of manufacturing a product, comprising:

(a) optimizing the process parameters in a production plant by a process according to any one of claims 19 to 27; and
(b) manufacturing the product in the optimized production plant.

29. A computer program comprising computer program code means which, when executed on a computer, instruct the computer to carry out the steps of a process according to any one of claims 19 to 27.

30. A computer readable medium having recorded thereon a computer program according to claim 29.

Figure 1



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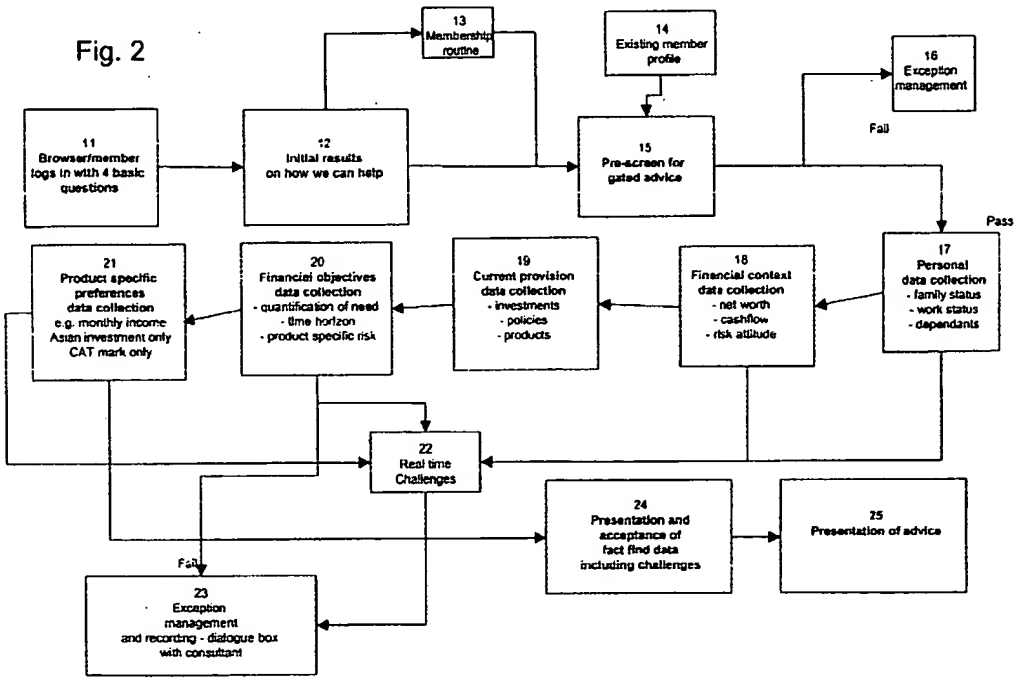
(54) Electronic financial advice method and system

(57) An electronic system provides financial advice based on personal data and financial objectives entered by users, by means of a rules engine. The rules engine detects whether the financial objectives match the personal data provided by the user and issues a challenge, or initiates a communication with a financial adviser, if they do not. The system stores general financial information and automatically provides updated financial advice to the user when the general financial information changes. The financial advice is in the form of a document compiled from text passages selected by matching predefined values to the user's personal data. The data and rules used to generate the financial advice are stored so as to be available for inspection, to demonstrate compliance with financial regulations.

Fig. 2



EP 1 139 257 A1

Description

[0001] The present invention relates to an electronic system for providing financial advice based on data provided by a user.

[0002] The world of personal finances and financial products is extremely complex and daunting for many individuals. With many hundreds, often thousands of products available in a market and a bewildering array of generic information sources available (e.g. newspapers, Internet web sites, TV etc.) this complexity is increased. As a result, financial advice which is tailored to an individual and which recommends a reasoned course of action specific to them is highly valued.

[0003] Traditionally, professional financial advice with this level of tailoring (i.e. specific to an individual) has only been available through a face-to-face meeting with an advisor. However, in a world in which convenient access to services electronically is increasingly important, this channel has significant drawbacks, in particular its lack of convenience.

[0004] Not surprisingly therefore, convenient electronic access to professional quality financial advice, tailored to an individual's specific circumstances is highly valued. It is not however currently provided.

[0005] There are a number of operators who provide information on the Internet and other electronic channels to customers as regards financial products that are on offer and approaches to financial planning. Some provide comparisons and produce 'Best Buy' lists. Some operators provide the capability for the customers to then purchase the relevant products on-line through an 'execution-only' process where the customer is not given any specific advice as to the suitability of the product for their needs. With these services the customer has to make the decision as to which product to purchase on their own.

[0006] Currently there are no convenient electronic services available which give the customer financial advice which is specific to them and reflects their personal situation.

[0007] These operators are generally described as Infomediaries and/or execution-only brokers. Some of these operators do provide to their users the option of being referred to a Financial Advisor, in the form of referral to a phone number, to a Web site or some similar process.

[0008] The advice process the customer subsequently receives is similar to the process that has existed for a number of years and has not yet changed significantly with the advent of the digital age. The best practice process is similar whether or not the customer is being advised on a regulated or unregulated product, however there are stringent enforceable compliance rules in relation to the advising of an individual in relation to a regulated product. Regulated products are prescribed by law and compliance rules on giving advice is regulated by a relevant authority (for instance; in the UK it would be the Personal Investment Authority (PIA) / Financial Services Authority (FSA)).

[0009] The basic process is as follows: a fact find/discovery is performed either by face-to-face interview, an on-line fact find, by post or some similar process. The advisor uses this to assess among other things the financial situation of the individual, their attitude to risk, their financial needs and aspirations. The key principle is that in order to advise a client specifically and according to best practice you must first 'Know your Customer' and their circumstances.

[0010] The reason that the advice process has not changed much with the advent of the Internet is that most companies in the financial services community are being very careful about ensuring that they are in full compliance with the regulatory advice rules. Whilst they may now collect the required fact find information on line, the remainder of the process is a mixture of manual review and advice work supported by some research (which may be sourced from an electronic database) and calculations (which may have some automated routines). The key thing is that there is a human financial advisor(s) at the centre of the process who pulls together the final financial and product advice and then decides that the advice is appropriate to deliver back to the client.

[0011] Due to the significant involvement of the human financial advisor the current process lacks convenience for the customer (there are frequently significant delays before first accessing an advisor and then subsequently receiving the advice) and the resultant advice and associated reports vary significantly in quality and consistency.

[0012] Customers cannot therefore currently obtain electronic, real time, financial advice specific to their situation, which is delivered in compliance with required regulatory compliance rules and is in line with the current generally accepted best practice processes for giving financial advice.

[0013] US 6,021,397 (Jones et al) concerns delivering to clients optimised investment portfolio allocations through interactive simulation to facilitate investment product selection. It is therefore heavily investment based and narrow in its application (the main concentration appears to be US orientated in the 401K area). It will also project these into the future to assist the client to reach specific financial goals. It is basically a financial modeller/calculator/forecaster for investments. There is no reference as to whether it is real time interactive with the client at all times, nor whether it is web based or requires human intervention at any point in the customer process. It does not cover non-investment products and does not address the issues of regulatory compliance.

[0014] US 5,920848 (Schutzer et al) concerns the use of computerised intelligent agents to facilitate the integration of details of financial transactions performed with computerised methods of financial accounting. Intelligent agents in the system also will take the informa-

tion collected and analyse it to provide users with user-specific financial reports, profiles and advice and under appropriate conditions take action. In overview this systems main claim is that it is integrating on-line banking activities with personal financial accounting. It appears to be transaction-based and does not deal in any depth with assessing the overall financial situation of the individual nor does it have a very well developed related advice engine. It does not address regulatory compliance.

[0015] US 5,913,202 (Motoyama/Fujitsu) describes a financial intermediary system which stores client preference information and information about financial products. On request by a client for a particular type of financial product, the system selects suitable products based on the client's preferences. The system also provides an investment analysis and consultation service.

[0016] US 5,987,434 (Libman) describes a system for automatically preparing communications to clients on financial products, based on stored client information, financial product information and decision criteria. The client communications can be sent via any of a number of different channels, including internet, voice or printed materials.

[0017] US 6,154,732 (Tarbox/GuidedChoice.com) describes a system for providing investment advice according to a set of rules developed by a financial expert and programmed into a computer. Users enter their details on a worksheet which is processed by the computer to create an investment recommendation. The worksheet may be submitted via a web page.

[0018] In one aspect of the present invention, the electronic financial system enables individuals seeking financial advice to gain access to financial advice individually tailored to their situation via electronic interfaces. The process is automated and advice is presented in real-time. The advice process is carried out through the application of computerised programmed rules which operates independently of human intervention other than normal maintenance activities, exception management and rules amendments. The electronic financial system is applicable to all areas of financial advice and all products (including but not limited to: cashflow planning, net worth management, retirement planning, saving and investing, financial protection of own and dependants' financial health, investments, savings, pensions, life assurance, general insurance, mortgages, credit cards and loans).

[0019] The electronic financial system may provide an automated, real-time customer consultation using electronic media to carry out an intelligent data collection process. This process asks a dynamic set of questions, challenges answers and provides dynamic prompts to help people consider their own situation in sufficient detail and as efficiently as possible. In this way the system is less tedious and more relevant than a static form filling exercise, it can also be completed in a much shorter period of time and is a better experience for the user.

[0020] The electronic financial system may provide an automated, real time process by which best-practice financial planning is applied to data collected on a customer's situation and their financial situation and needs assessed.

[0021] The computerised rules may identify, in real time, individuals who cannot be advised automatically and offers them alternative options. We call this Exceptions Management.

[0022] The electronic financial system may provide an automated, real time process by which a range of different financial solutions and, if appropriate, products from one or more companies are analysed and assessed in relation to a customer's needs. A number of these products may be selected and recommended as best suited to meet the needs of the individual and reasons why this is the case may be created dynamically. Products advised upon may include, but are not restricted to, investments, savings, pensions, life assurance, general insurance, mortgages, credit cards and loans.

[0023] This advice may be presented via an automated, real time and dynamic audio/visual presentation accessed electronically or via other media. The presentation of advice is tailored to an individual customer and describes their specific financial needs and priorities, articulates their options and recommends a solution. Where appropriate it also makes specific recommendations as to which product(s) is/are best for them based on their identified financial needs. It also presents detailed reasons why in an easy to assimilate format.

[0024] The electronic financial system may provide this advice through a process which is compliant, where applicable, with the regulator's requirements, voluntary codes of practice and generally accepted financial advice best practice. In particular the process demonstrates: sufficient knowledge of a customer's situation, the suitability of any advice given, that a range of products have been considered and that the best one(s) were selected/recommended to meet the customer's needs.

[0025] Specific embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a diagram illustrating the core elements used within the electronic financial system;

Figure 2 is a flow diagram illustrating one embodiment of the advisory stages through which the customer passes;

Figure 3 is a diagram illustrating one embodiment of the technical architecture used to run the electronic financial system;

Figure 4 shows a specific example of questions a customer is asked to determine how a particular service would meet their needs;

Figure 5 shows a specific example of a response to a customer after their submission of information;

Figure 6 shows a specific example of questions

asked to obtain important personal information;
Figure 7 shows a specific example of a 'challenge', which questions a customer's view or response;
Figure 8 shows a specific example of a screen responding to an exception during the exceptions management process;
Figures 9 and 10 are tables which show two examples of a series of rules used to drive advisory recommendations; and
Figures 11 and 12 show two specific examples of the presentation of advice.

[0026] A system which enables individuals to obtain financial advice, individually tailored to their specific situation, via any electronic interface, is described. The core processes used within this system are illustrated in one embodiment in Figure 1 and in more detail in Figure 2.

[0027] As shown in Figure 1, the processes comprise a data collection/consultation stage 1, an application stage 2 at which rules conforming to best practice are applied to the collected data, an exceptions management stage 3 which is executed if the data does not conform to parameters set by the rules, a selection stage 4 where a range of financial products or solutions is selected based on the collected data, and a presentation stage 5 where the selected financial products or solutions are displayed. At each stage, the nature of the data collected, the rules which are applied and the information supplied to the user are designed to comply with the necessary financial regulations (stage 6).

[0028] Figure 2 illustrates the range of advisory stages through which a customer may pass. At stage 11, a user who is not already registered as a member logs into the system by answering four basic questions about their investment objectives (for example, which tax year they wish the advice to apply to, how much they wish to invest and how often) and their attitude to risk. At stage 12, the system selects an initial set of results based on the answers to the basic questions and displays these to the user. The results may be a general indication of types of recommendation that can be provided by the system. The user may then register as a member at stage 13, by choosing a user name and password which are recorded by the system so that data entered by the user can be retrieved in subsequent sessions. If already registered as a member, the user logs in at stage 14.

[0029] In either case, the user is then presented at stage 15 with a pre-screen for gated advice. If there is a fail condition, the system passes to an exception management procedure at stage 16 where the system determines which of several options, for example, email, chat session or telephone, to suggest the user receives advice from a qualified financial adviser. The fail condition will arise in cases where the systems rules identify that the case cannot be advised real time on-line without the direct assistance of a qualified financial adviser. An example of such a condition is if the user's investment preferences (for example investment time horizon) do not match with the investment methodology defined within the system or the user already holds an investment product which makes them ineligible to purchase another in the current tax year.

[0030] If there is a pass condition, the user is presented at stage 17 with a web form for the collection of personal data relating for example to family status, work status and any dependents. Once this information has been entered and submitted, the user is presented at stage 18 with a financial context data collection form in which the user enters details such as their net worth, cashflow and risk attitude. Once this information has been entered and submitted, the user is presented at stage 19 with a current provision data collection form in which the user enters details of any investments, policies and products already held. Once this information has been entered and submitted, the user is presented at stage 20 with a financial objectives data collection form in which the user enters information such as quantification of need, time horizon and product-specific risk. Once this information has been entered and submitted, the user is presented at stage 21 with a product specific preferences form in which the user enters specific preferences such as a monthly income requirement, Asian investment only, or CAT mark products only.

[0031] At any of stages 17, 18, 20 and 21, the system checks the data submitted by the user against a set of criteria designed to test whether the data is realistic or likely to be correct. If the data fails to meet these criteria, a challenge screen is presented to the user at stage 22, asking whether the submitted data is correct. If the user confirms that it is correct, the system proceeds to the next stage. If the user indicates that the data is not correct, the system returns to the display of the form from which the data was submitted, to allow the user to amend the data.

[0032] At stage 20, the system checks the financial objectives against a set of criteria designed to test whether the user's objectives are suitable or realistic, given the information collected in the previous stages. If the financial objectives fail this test, then the user passes to an exception management stage 23, in which consultation with a human operator is initiated, as described in greater detail below.

[0033] After stage 21 the data entered by the user, together with an indication of any challenges made by the system and the fact that the user confirmed the data was correct, is presented to the user, who is prompted to confirm that the data is correct and that the conditions under which financial advice is given have been accepted. If the user confirms the data, financial advice is presented to the user at stage 25.

Access to advice

[0034] The automated, real time customer consultation can be accessed via any electronic interface, includ-

ing, but not restricted to personal computers, personal digital assistants, kiosks, internet web browsers, digital (satellite and terrestrial) TV, web telephones and smart cards. Figure 3 shows one embodiment of the technical architecture used to run the electronic financial system and clearly shows the range of interface media which may be used.

[0035] In a presentation layer, the user may access the system using a web browser under HTTP/HTML protocols, a digital TV under HTTP/HTML protocols, a mobile terminal or PDA using WAP/WML protocols, or a text-based device using SMS or e-mail protocols. In general, the system provides an electronic apparatus which is accessible by client terminals using any suitable communications network and means for input and display. The electronic apparatus provides Java based electronic apparatus pages to the client terminals by means of a JDBC/CORBA interface to an application layer running on the same or another server.

[0036] The application layer comprises a business rules engine, such as Usoft Definer™, incorporating a set of financial advisory rules, and a web personalisation rules engine, such as Informix I.Sell™ (which is a re-branded version of ATG's Dynamo™ product). Both of these applications access a data layer comprising a database platform such as Informix Internet Foundation 2000™ and a database of data relating to financial products and other information compiled from news reports, such as tax and interest rates and savings tax thresholds.

[0037] The infrastructure is provided by an application service provider and web hosting services providing web servers, application servers and database servers, running on suitable server hardware and operating systems, such as Sun Solaris™.

[0038] The combination of the core hardware and software components offers users a convenient access to best practice financial planning and presentation of advice. The protocols for running, and communicating between, individual components ensure that the system operates at a level of effectiveness such that customers can gain quick and efficient access to the system.

Data Gathering

[0039] The data gathering stages 17 to 21 involve the gathering and recording of relevant personal and financial information for the purpose of establishing an individualised customer profile. This method creates an effect of experiencing a conversation by requesting information from the customer in an intelligent way and immediately responding with (that is displaying or verbalising through their electronic interface) relevant suggestions, instructions and information.

[0040] An example of stage 11 of this method is provided in Figure 4, with a web form comprising questions asked of a customer to determine how a particular investment advice service would meet their needs. In this case, the questions relate to financial advice concerning an ISA (Individual Savings Account).

[0041] An example of stage 12 is shown in Figure 5, in which a specific response is provided to the customer, showing the availability of a particular type of investment, how this advice will be charged and how the advisory process will work for them. This is an example of a query on the underlying database, taking the user's criteria and assessing how many products currently match them. The power of this query process comes from *a priori* evaluation and tagging of database records to reflect their use to the customer e.g. as 'income' or 'growth' or 'low', 'medium' or 'high' risk.

[0042] The technique for gathering and recording personal and financial information for the purpose of establishing a customer profile uses rules defined in a computer-programmed application to control the collection of the data required.

[0043] To maximise the convenience and efficiency of the process for the customer, the system automatically records the data entered by the customer at the completion of each step in the data collection process to facilitate the completion of data collection in one session or over many sessions, to allow the completion of the data collection activity via different electronic interfaces over any period of time, and to allow the customer to advance through a series of data collection steps and to return to previous steps to amend data.

[0044] The programmed rules are executed when specific data values are entered via the electronic interface causing the following types of action to occur:

- analysis of the source of input (that is which form of electronic interface was used) to determine and subsequently control the presentation of forms (for data entry) and any content (including, but not restricted to, text, graphics, video and audio);
- analysis of the data input to determine its validity (according to predefined syntax rules and acceptable values or ranges of values);
- analysis of the data input to determine which questions to present and in which order;
- analysis of the data to determine which calculations to perform and what content must be extracted (if it is static content) or derived (if the content must be composed automatically);
- analysis of the data input to determine what the composition of the next screen should be and subsequently to issue instructions and content (including, but not restricted to text, graphics, video and audio) to the presentation software which actually assembles all the components of the screen;
- analysis of the data to determine which, if any, background tasks must be performed, including but not restricted to, database updates and sending emails;
- analysis of the data to determine whether specific regulatory, legal or fiscal conditions would be breached and subsequently to issue the correct ad-

vice to the customer indicating what course of action is required given those circumstances; and

- analysis of the data to determine what, if any, advice, using best practice financial planning rules, should be presented to the user to make them aware of the implications of their situation and to cause them to acknowledge a suggested course of action or refine their objectives.

[0045] The effect of these analytical processes and the dynamic creation of content which is displayed or verbalised back to the customer, is to create a series of interactions between the customer and the electronic interface which, in real time, prompts the customer to consider their situation in detail, quickly and conveniently.

Application of best practice financial planning

[0046] The application of best practice financial planning practices, which are embodied the computerised rules, ensures appropriate questions are asked and specific and relevant advice is given to the customer in real time, as they interact with the process. Figure 6 shows an example of the types of important personal information that are entered to invoke financial planning rules to determine how the customer's needs should be addressed.

[0047] The financial planning rules will determine situations where a customer's requirements may not be appropriate. An example of this challenge, as occurs at step 22, is shown in Figure 7. In this instance a customer has a negative net cash flow. The rule used states that for users where net income minus expenditure, minus the amount to be invested (if regular) is negative, then a challenge as to the investment's affordability should be raised. The user may indicate that they wish to proceed, or may return to a previous stage to modify the data entered.

Automatic Update

[0048] The system automatically invokes rules when any change in the value of any data field used by the rules occurs or a specific event occurs, which may be time sensitive. Where the rules engine determines that the change in the data value requires a business rule to be processed, this can produce a range of effects such as:

- the automatic update of financial forecasts and calculations and any other variable data value;
- the automatic invocation of financial planning rules which determines the content and form of financial advice to be sent to the customer;
- the automatic composition of the advice, according to presentation rules and preferences provided by the customer about how they want to receive such advice updates; or
- the automatic posting of the advice to the appropriate electronic device or service.

[0049] Therefore, the process for automatically generating advice, as well as being in real time, can also be provided in response to a specific event, such as a change in age, changes to employment, income, tax rates or stock market prices.

Exception management

[0050] The rules will also determine whether a specific combination of data values relating to the customer will not permit the system to complete the data collection process and will not, therefore be able to complete the automatic provision of advice or product recommendations - called exception management.

[0051] The system will automatically indicate to the customer that their case cannot be processed and will offer one of several alternative courses of action, according to rules which determine the most efficient and effective option.

[0052] The options include, but are not restricted to:

- presentation of a form to facilitate collection of free-form data which is emailed to qualified financial advisors who can manually assess the case and contact the customer;
- presentation of a new window, known as a chat box, which facilitates a real time, text based conversation between the customer and a qualified financial adviser;
- presentation of a new form facilitating a request for a telephone based interaction, which if submitted by the customer will schedule a call back to the customer.

[0053] An example of the exception process is shown in Figure 8. The relevant rule states for example that where a customer is aged 75 or over then this service is not appropriate for them and the exception management process should be invoked. In this example, the user may click on a button to bring up a form which is completed and emailed to a financial adviser. The financial adviser can then contact the customer to discuss their requirements.

Selection and Recommendation

[0054] The selection and recommendation of a financial product (including, but not restricted to, investments, savings, pensions, life assurance, general insurance, mortgages, credit cards and loans) which is appropriate and suitable for the specific individual is controlled by rules defined and invoked by a computer system.

[0055] The completion of specific data values in a customer profile is analysed by the system and uses best

practice financial planning rules to automatically match product records suitable to the customer's specific needs and situation. An example of this in one embodiment of the invention in an Individual Savings Account advice module, can be described as follows:

If the customer is:
Aged between 18 and 75; and
Not unemployed; and
Not terminally ill; and
Wishes to invest within Inland Revenue limits; and
Has a risk tolerance sufficient for the stockmarket; and
Has an investment horizon of 4 years or more; and
Has no existing ISA investment; and
Is a UK resident for tax purpose; and
Can afford the investment

[0056] Then state that "An ISA investment would be suitable for you". Otherwise explain which characteristics are inappropriate and invoke a challenge/exception management.

If an ISA is suitable and the customer is
Working; and
Not within 5 years of retirement

[0057] Then state that "We suggest you use your ISA to invest for long term growth". Else use the net income analysis module to assess whether to recommend an income objective.

If the growth recommendation is accepted, and
Risk tolerance level selected is equal to or greater than "Careful Investor" (Five levels of risk tolerance are assessed based on answers to a number of questions)

[0058] Then request level of returns sought.

[0059] If level of returns sought (there are five levels of possible returns, assessed based on a number of questions) is not in excess of risk tolerance level then select appropriate ISA fund product group according to their pre-allocated risk and return ratings. If not then challenge whether customer understands how much risk is involved with the level of returns requested and suggest a lower level.

[0060] If appropriate level of returns are agreed and the customer wishes specific preferences to be taken into account e.g. no funds with a front end charge, then use product rankings within risk return peer group to eliminate those without preferred characteristics in descending order.

[0061] Display selected products with reasons why they are strong investments and appropriate to customer.

[0062] The rules are defined indicating, for any given values in a customer profile, which products are considered most suitable, through:

- a value (or values) assigned to the product record by an expert, which is evaluated regularly and may change, indicating its ranking amongst its peer group for a specific customer profile,
- a value (or values) automatically generated by the system, according to a set of prescribed rules, which the system can then use to dynamically rank a product amongst its peer group for a specific customer profile,
- values that are used to quantify both hard variables, such as price and performance and softer, less tangible, variables such as risk, brand strength and service quality.

[0063] An example of a rule matrix used to drive advisory recommendations is shown in Figures 9 and 10.

Presentation of advice

[0064] Specific preferences, stated explicitly by the customer or implied by the interface device being used to access the service, are stored as values which can be accessed by rules which determine the form (electronic text, digitised audio or video or in print) in which the customer wishes to receive their advice and when it is to be delivered. These presentation rules have the effect of creating a dynamic way of delivering financial advice.

[0065] Advice received by the customer is saved automatically and is time, date stamped for future review. The advice presentation record pulls together in one document the content which explains the customer's specific financial needs and priorities, articulates their options and recommends a solution. Where appropriate it also makes specific recommendations as to which product(s) is/are best for them based on their financial needs. Specific examples of this are shown in Figures 11 and 12.

[0066] The user's data values are pattern matched to expected values to determine which business rules must be processed. The business rules describe what content should be created to insert into the report and what sequence. The content itself consists of prepared paragraphs, sentences and words, which are indexed with values which are analysed and matched to criteria in the business rule to determine of they should be used, and sentences where many of the values must be resolved from variables to fixed forms.

[0067] The process by which variables in pre-prepared sentences are resolved to their fixed forms involves parsing the sentence to identify the variable, identifying where the value for the variable is to be obtained, processing any business rules which may be needed, for example, if the variable must be calculated, retrieving the value and then inserts the fully resolved sentence in the place determined by the report genera-

tion business rules.

[0068] An advice presentation record can be updated by a customer amending information about themselves. Computerised rules analyse amendments and control when a new presentation is created. The system will create a history of advice presentation records which can be viewed by the customer and by regulatory inspectors.

[0069] As well as the presentation of advice, the content of the advice and recommendations is also dynamically generated according to rules in the system, including, but not restricted to:

- which content to extract from the database,
- how to format it, in terms on colour, size, font and position,
- which variable content to automatically compose and insert,
- where to insert variable content,
- through which media to present it (electronic, printed matter or digitised voice).

[0070] The rules analyse the following types of data to determine how to compose and present the advice and recommendations:

- specific features of the customer profile and customer contact preferences,
- best practice financial planning rules,
- regulatory, legal and fiscal rules,
- composition rules which describe the artistic look to be achieved and the appropriate selection of content (text, graphics, video or audio, etc.) to ensure compatibility with the customer's preferred media protocol (HTTP, WAP, paper etc.).

[0071] These rules ensure the advice is individually tailored to the customer.

Ensuring compliance

[0072] Rules are also defined to ensure the process for advising on particular courses of action and suitable products satisfies regulatory, legislative and fiscal requirements.

[0073] When data entered by the customer is analysed by the system, it determines whether a breach of these rules has occurred or may occur.

[0074] The presentation of the advice to the customer concerning an actual or possible breach of regulatory, legal or fiscal rules is in the form of either:

- an error message which prevents the customer continuing with the service,
- a warning which the customer must acknowledge, confirming acceptance of any conditions or restrictions under which the advice will be given,
- an exception which prevents the customer from continuing with the service and requires the customer to interact with a qualified financial advisor.

[0075] The automation of the solution/product analysis and selection process, controlled by the computerised rules, ensures that the appropriate range of solutions/products is assessed and the best ones are recommended.

[0076] Every customer interaction with the system, the updating of every data element in the system, including the customer profile, products database and even updates to the rules themselves, is recorded to provide a complete audit trail for both internal and external inspection (including compliance monitoring by the regulatory authorities).

[0077] Other embodiments may be envisaged which nevertheless fall within the scope of the present invention.

Claims

1. A method of electronically providing financial advice to a user, comprising:

   a. receiving personal data from the user;
   b. receiving financial objective data relating to one or more financial objectives from the user;
   c. storing one or more financial rules;
   d. processing said personal data and financial objective data according to said financial rules so as to determine the suitability of the financial objective data to the personal data; and
   e. if the financial objective data is determined, at step d, not to be suited to the personal data, transmitting a request to the user to confirm the data received from the user.

2. A method according to claim 1, including, after step e, receiving a confirmation of the data from the user, and electronically providing financial advice to the user on the basis of the personal data and financial objective data received at steps a and b.

3. A method according to claim 1, including, after step e, receiving amended personal data and/or financial objective data from the user, and electronically providing financial advice to the user on the basis of the personal data and financial data incorporating said amended personal data and/or financial objective data.

4. A method according to claim 2, including storing a request indication that the request to confirm was sent to the user and a confirmation indication of the confirmation by the user, and presenting the request indication and the confirmation indication when the financial advice is electronically provided to the user.

5. A method of electronically providing financial advice to a user, comprising:

a. receiving personal data from the user;
b. receiving financial objective data relating to one or more financial objectives from the user;
c. storing one or more financial rules;
d. processing said personal data and financial objective data according to said financial rules so as to determine the suitability of the financial objective data to the personal data; and
e. if the financial objective data is determined, at step d, not to be suited to the personal data, initiating a communication between the user and a financial adviser.

6. A method according to claim 5, wherein said communication is initiated by presenting an electronic form to the user for the collection of additional data.

7. A method according to claim 5, wherein said communication comprises a real-time, text-based duplex communication.

8. A method according to claim 5, wherein said communication is initiated by presenting to the user a request form for a telephone-based interaction.

9. A method of receiving financial advice from an electronic apparatus, comprising:

a. sending personal data to an electronic apparatus;
b. sending financial objective data relating to one or more financial objectives to the electronic apparatus; and
c. if said personal data is determined by the electronic apparatus not to be suited to said financial objective data according to financial rules stored by the electronic apparatus, receiving a request to confirm the data sent to the electronic apparatus.

10. A method according to claim 9, including, after step c, sending a confirmation of the data to the electronic apparatus, and electronically receiving financial advice from the electronic apparatus on the basis of the personal data and financial objective data sent at steps a and b.

11. A method according to claim 9, including, after step c, sending amended personal data and/or financial objective data to the electronic apparatus, and receiving financial advice from the electronic apparatus on the basis of the personal data and financial data incorporating said amended personal data and/or financial objective data.

12. A method according to claim 10, including receiving an indication that said confirmation was sent when receiving the financial advice.

13. A method of receiving financial advice from an electronic apparatus, comprising:

a. sending personal data to an electronic apparatus;
b. sending financial objective data relating to one or more financial objectives to the electronic apparatus; and
c. if said personal data is determined by the electronic apparatus not to be suited to said financial objective data according to financial rules stored by the electronic apparatus, receiving an initiation of a communication with a financial adviser.

14. A method according to claim 13, wherein said initiation comprises an electronic form for the collection of additional data.

15. A method according to claim 13, wherein said communication comprises a real-time, text-based duplex communication.

16. A method according to claim 13, wherein said initiation comprises a request form for a telephone-based interaction.

17. A method of electronically providing financial advice to a user, comprising:

a. receiving personal data from a user;
b. receiving financial objective data relating to one or more financial objectives of the user;
c. storing one or more financial rules;
d. storing financial data not specific to said user;
e. in response to a change in any of said personal data, financial objective data, financial rules or financial data, processing said personal data, financial objective data and financial data according to said financial rules so as to generate said financial advice, and
f. transmitting said financial advice to the user.

18. A method according to claim 17, wherein step e is performed in response to a change in said financial data.

19. A method according to claim 17 or 18, including determining whether said change requires the generation of financial advice, wherein steps e and f are performed only if the generation of financial advice is determined to be required.

20. A method of electronically providing financial advice to a user, comprising:

a. receiving personal data from a user;
b. receiving financial objective data relating to one or more financial objectives of the user;
c. storing one or more financial rules including expected personal data values;
d. storing text passages including variables;
e. compiling said financial advice by matching said personal data to said expected personal data values so as to select one or more of said business rules, applying said selected one or more business rules so as to select one or more of said text passages, calculating values of the variables of the selected text passages, and compiling said selected text passages and calculated values to generate a financial advice document; and
f. transmitting said financial advice document to the user.

21. A method of electronically providing financial advice to a user, comprising:

a. receiving personal data from a user;
b. receiving financial objective data relating to one or more financial objectives from the user;
c. storing one or more financial rules;
d. processing said personal data and financial objective data according to said financial rules so as to generate said financial advice; and
e. transmitting said advice to the user;

wherein the generated financial advice, the values of the personal data and financial objective data from which the financial advice was generated are stored so as to be accessible subsequent to said financial advice being transmitted to the user.

22. A method according to claim 21, wherein the state of the financial rules is stored so as to be accessible subsequent to said financial advice being transmitted to the user.

23. A method according to claim 21 or 22, wherein the user is presented with the terms and conditions of receiving the financial advice prior to step e, and step e is performed only if an acceptance of the terms and conditions is received from the user.

24. A method according to any one of claims 1 to 8 and 17 to 23, wherein the data is received from the user and the financial advice is provided to the user over a communications network.

25. A method according to claim 24, wherein said network is a public packet-switched network.

26. A method according to any one of claims 9 to 16, wherein said data is sent and the financial advice is received over a communications network.

27. A method according to claim 26, wherein said network is a public packet-switched network.

28. A method according to claim 27, wherein said electronic apparatus is a server.

29. A computer program arranged to perform the method of any one of claims 1 to 8 and 17 to 25 when executed by a suitably arranged computer.

30. A carrier bearing a computer program according to claim 29.

31. A system for providing financial advice automatically to a user terminal from a server connected to a network, comprising:

a. a database storing personal data and financial objective data relating to one or more financial objectives of the user, received from the user over the network;
b. a rules engine storing one or more financial rules and processing said personal data and financial objective data according to said financial rules so as to determine the suitability of the financial objective data to the personal data; and
c. a communications interface connected to the network, for transmitting a request to the user to confirm the data received from the user if the rules engine determines that the financial objective data is not suited to the personal data.

32. A system for providing financial advice automatically to a user terminal from a server connected to a network, comprising:

a. a database storing personal data and financial objective data relating to one or more financial objectives of a user, received from the user over the network;
b. a rules engine storing one or more financial rules and processing said personal data and financial objective data according to said financial rules so as to determine the suitability of the financial objective data to the personal data; and
c. a communications interface for initiating a communication between the user and a financial adviser if the rules engine determines that the financial objective data is not suited to the personal data.

33. A system for providing financial advice automatical-

ly to a user terminal from a server connected to a network, comprising:

a. a database storing personal data and financial objective data relating to one or more financial objectives of a user, received from the user over the network;
b. a database storing financial data not specific to said user;
c. a rules engine storing one or more financial rules and processing said personal data and financial objective data according to said financial rules in response to a change in any of said personal data, financial objective data, financial rules or financial data so as to generate said financial advice, and
d. a communications interface connected to the network for transmitting said financial advice to the user.

34. A system for providing financial advice automatically to a user terminal from a server connected to a network, comprising:

a. a database storing personal data and financial objective data relating to one or more financial objectives of the user, received from the user over the network;
b. a rules engine storing one or more financial rules including expected personal data values;
c. a database storing text passages including variables;
d. a compiler for compiling said financial advice by matching said personal data to said expected personal data values so as to select one or more of said business rules, applying said selected one or more business rules so as to select one or more of said text passages, calculating values of the variables of the selected text passages, and compiling said selected text passages and calculated values to generate a financial advice document; and
e. a communications interface connected to the network for transmitting said financial advice to the user.

35. A system for providing financial advice automatically to a user terminal from a server connected to a network, comprising:

a. a database storing personal data and financial objective data relating to one or more financial objectives of the user, received from the user over the network;
b. a rules engine storing one or more financial rules and processing said personal data and financial objective data according to said financial rules so as to generate said financial advice;
c. a communications interface connected to the network for transmitting said advice to the user; and
d. a store for storing the generated financial advice, the values of the personal data and financial objective data from which the financial advice was generated, so as to be accessible subsequent to said financial advice being transmitted to the user.

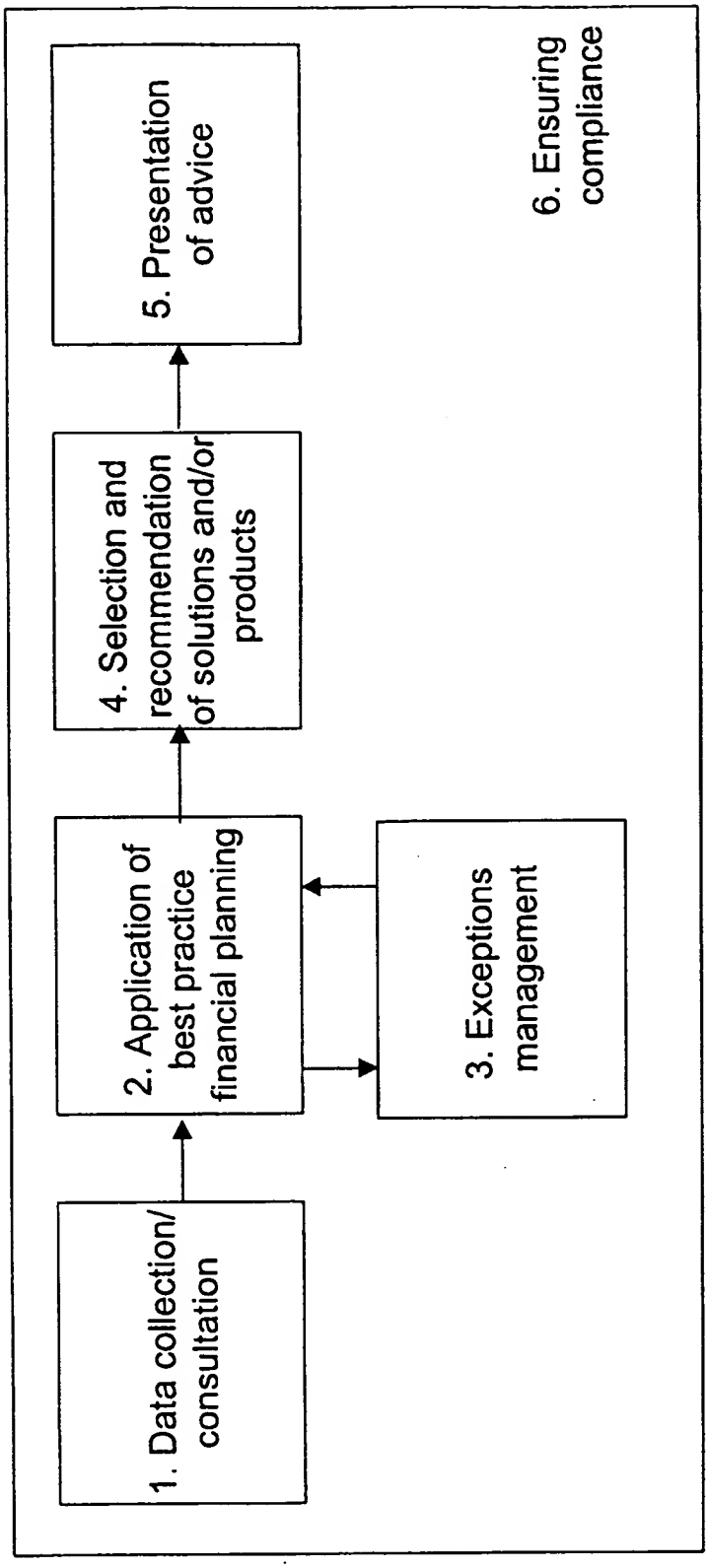

1. Data collection/ consultation
2. Application of best practice financial planning
3. Exceptions management
4. Selection and recommendation of solutions and/or products
5. Presentation of advice
6. Ensuring compliance

Fig. 1

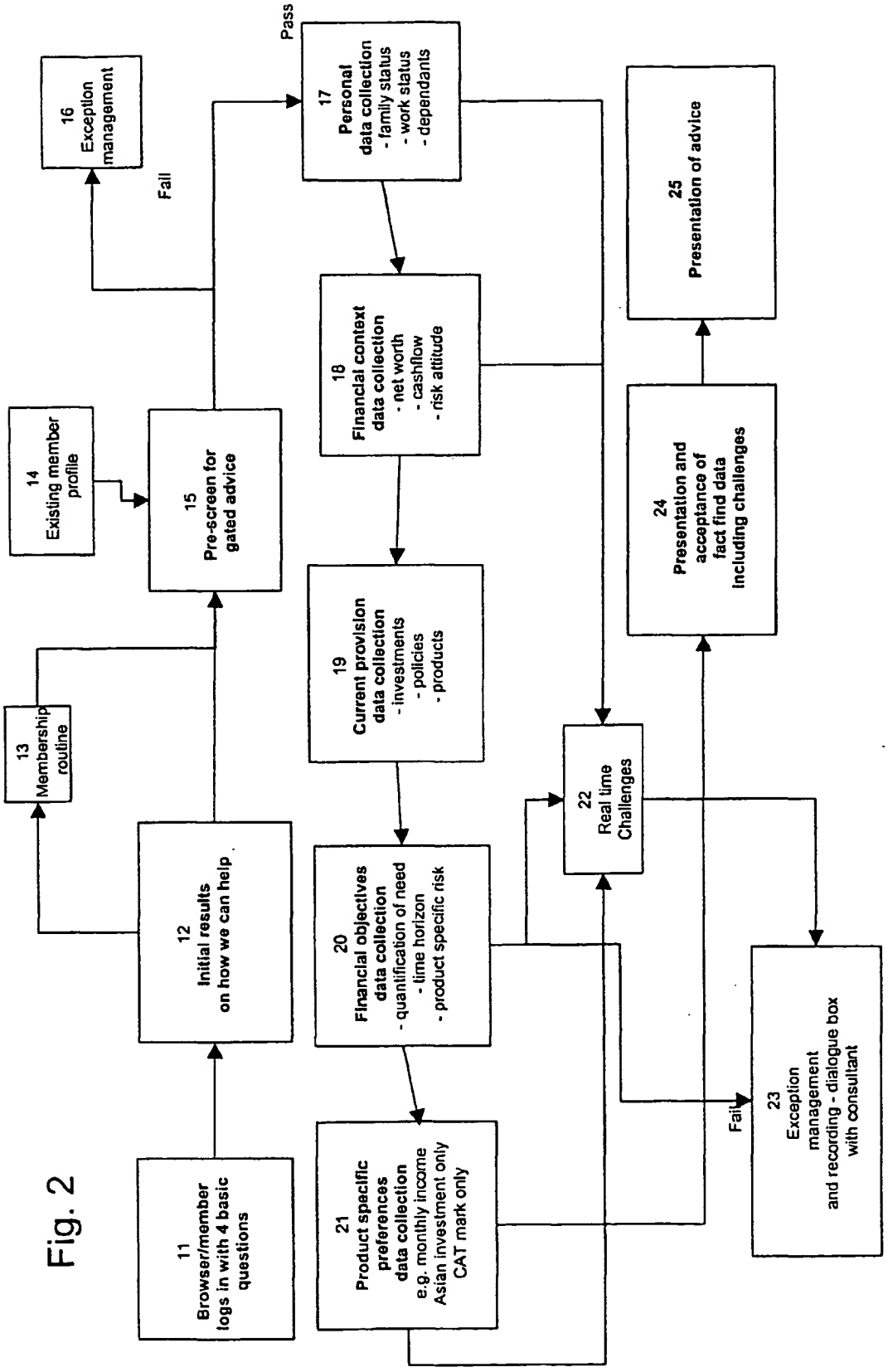

11
Browser/member logs in with 4 basic questions
12
Initial results on how we can help
13
Membership routine
14
Existing member profile
15
Pre-screen for gated advice
16
Exception management
Fail
Pass
17
Personal data collection
- family status
- work status
- dependants
18
Financial context data collection
- net worth
- cashflow
- risk attitude
19
Current provision data collection
- investments
- policies
- products
20
Financial objectives data collection
- quantification of need
- time horizon
- product specific risk
21
Product specific preferences data collection
e.g. monthly income
Asian investment only
CAT mark only
22
Real time Challenges
Fail
23
Exception management and recording - dialogue box with consultant
24
Presentation and acceptance of fact find data including challenges
25
Presentation of advice

Fig. 2

Fig. 3

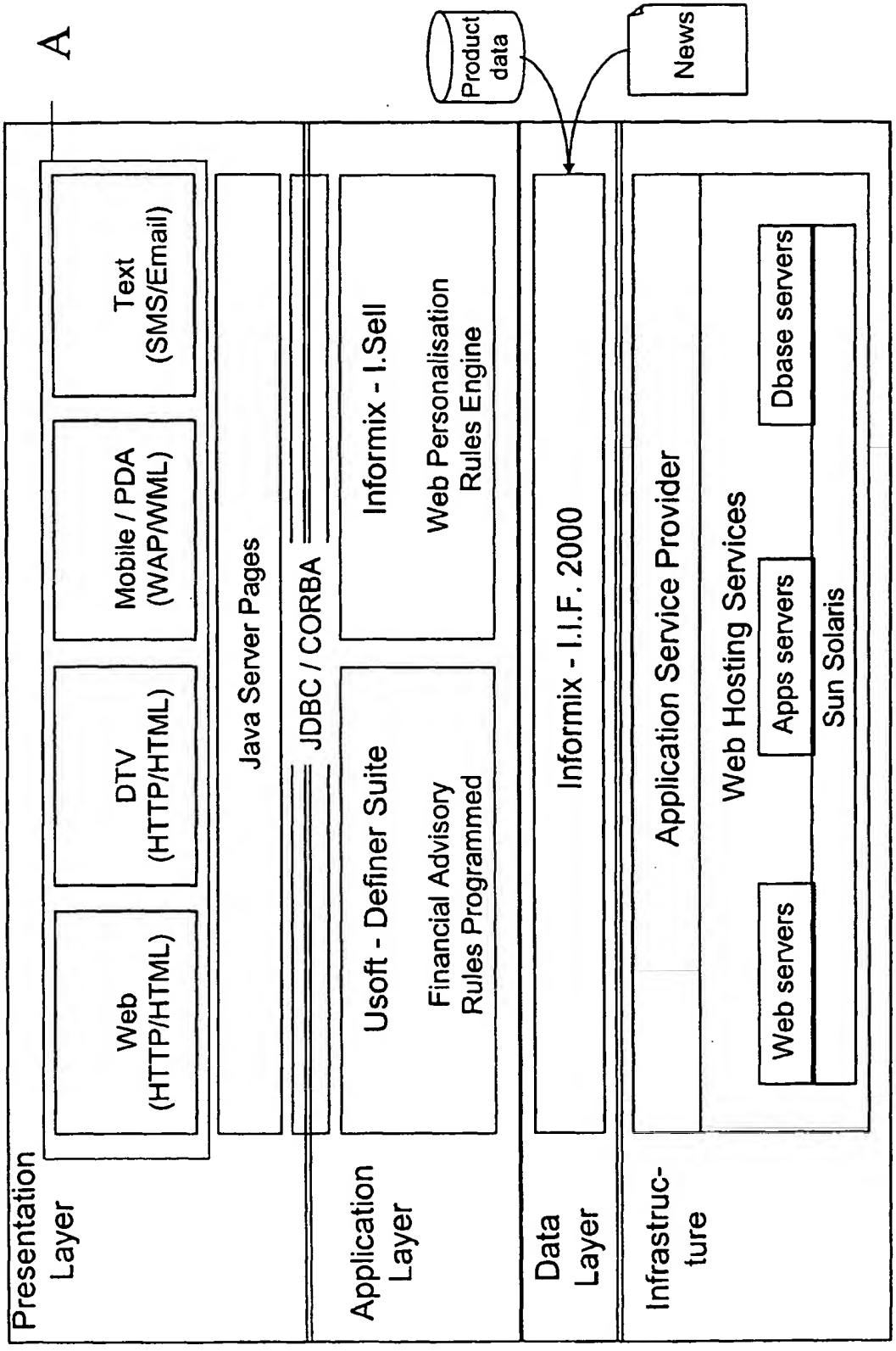

A
Presentation Layer
Web (HTTP/HTML)
DTV (HTTP/HTML)
Mobile / PDA (WAP/WML)
Text (SMS/Email)
Java Server Pages
JDBC / CORBA
Application Layer
Usoft - Definer Suite
Financial Advisory Rules Programmed
Informix - I.Sell
Web Personalisation Rules Engine
Data Layer
Informix - I.I.F. 2000
Product data
News
Infrastruc-ture
Application Service Provider
Web Hosting Services
Web servers
Apps servers
Dbase servers
Sun Solaris

Fig. 4

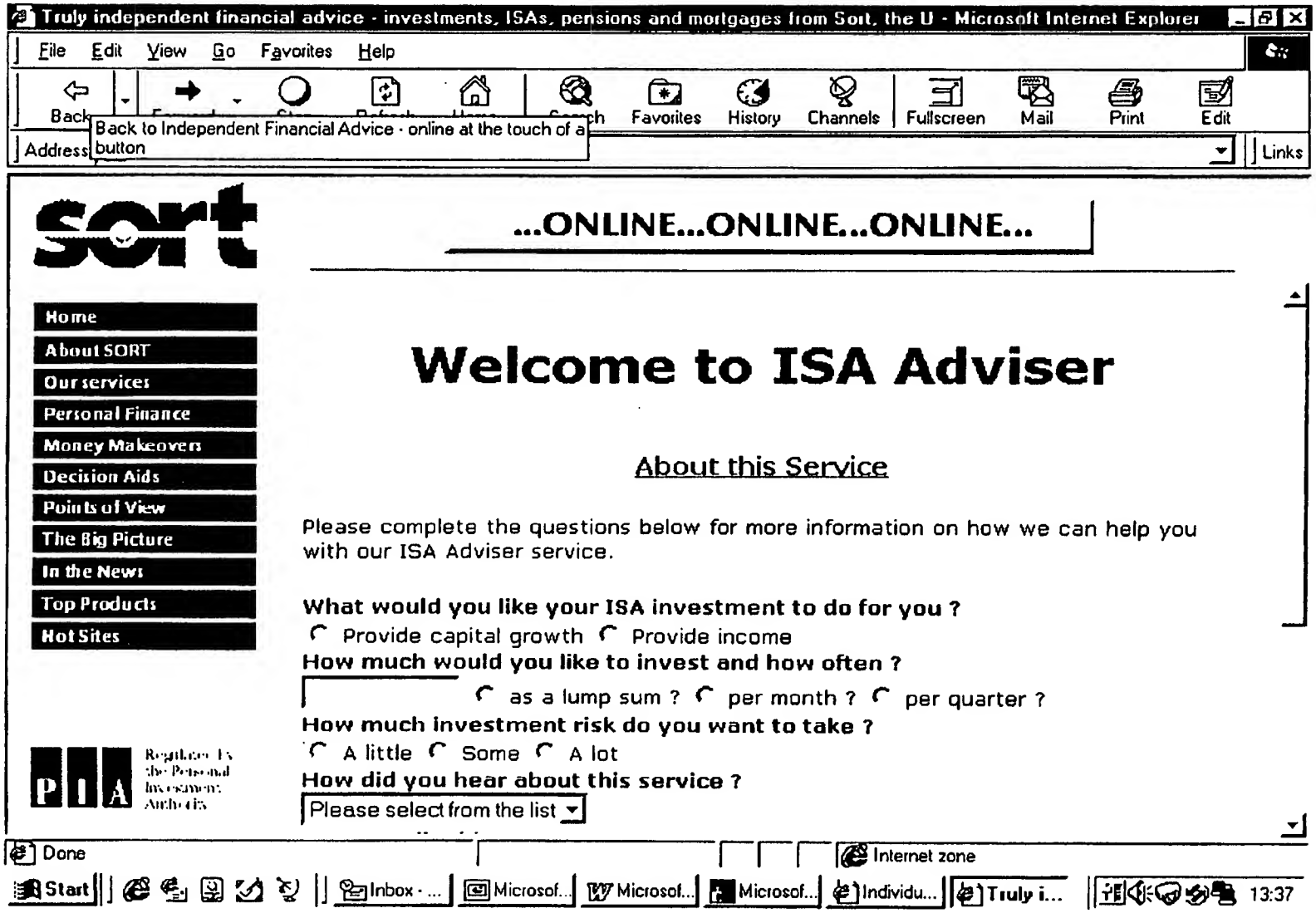


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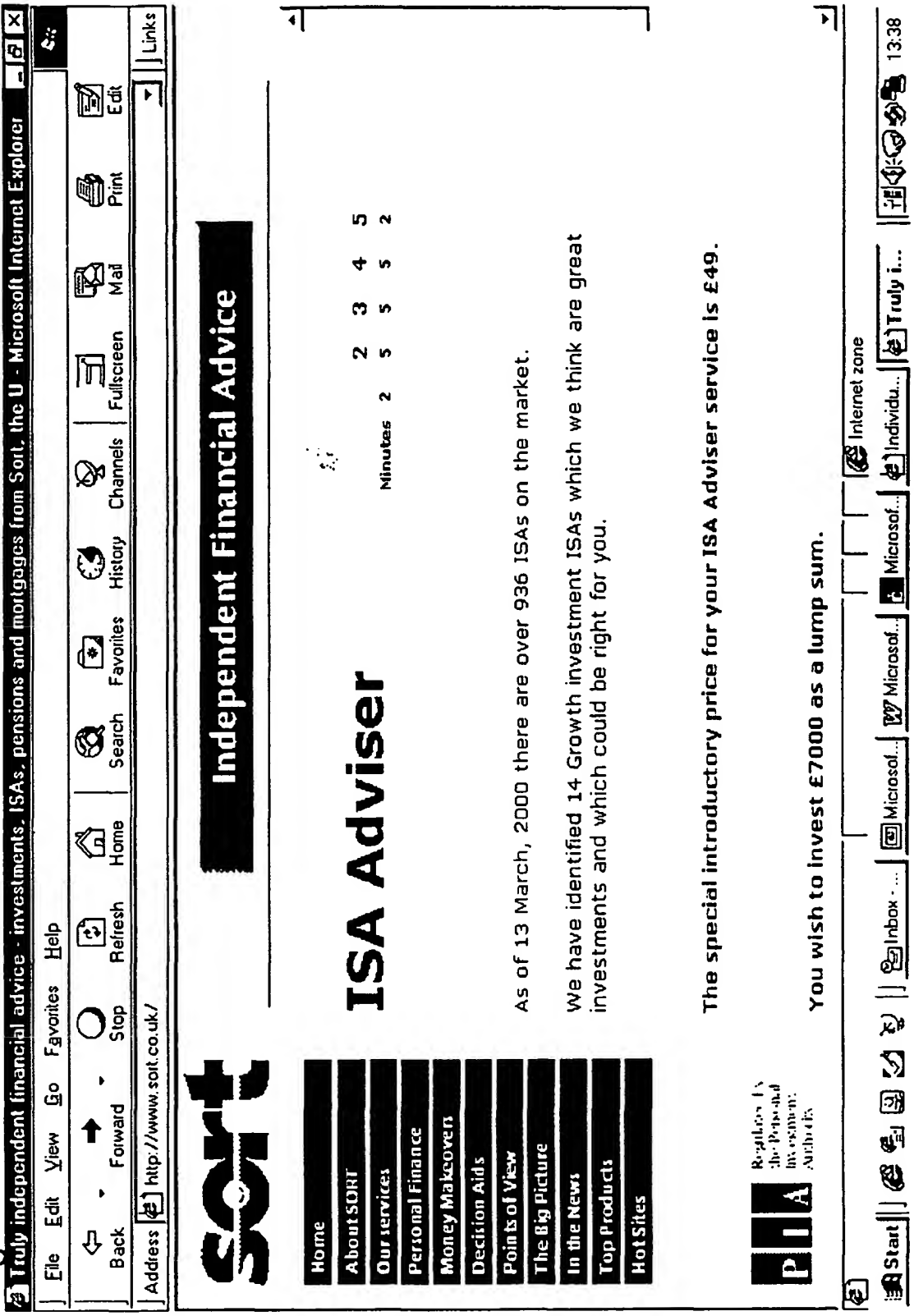
Fig. 5


Truly independent financial advice - investments, ISAs, pensions and mortgages from Sort, the U - Microsoft Internet Explorer
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Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://www.sort.co.uk/
Links
sort
Independent Financial Advice
Home
About SORT
Our services
Personal Finance
Money Makeover
Decision Aids
Points of View
The Big Picture
In the News
Top Products
Hot Sites
ISA Adviser
Minutes 2 2 3 4 5
5 5 5 2
As of 13 March, 2000 there are over 936 ISAs on the market.
We have identified 14 Growth investment ISAs which we think are great investments and which could be right for you.
The special introductory price for your ISA Adviser service is £49.
You wish to invest £7000 as a lump sum.
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Start
Inbox - ...
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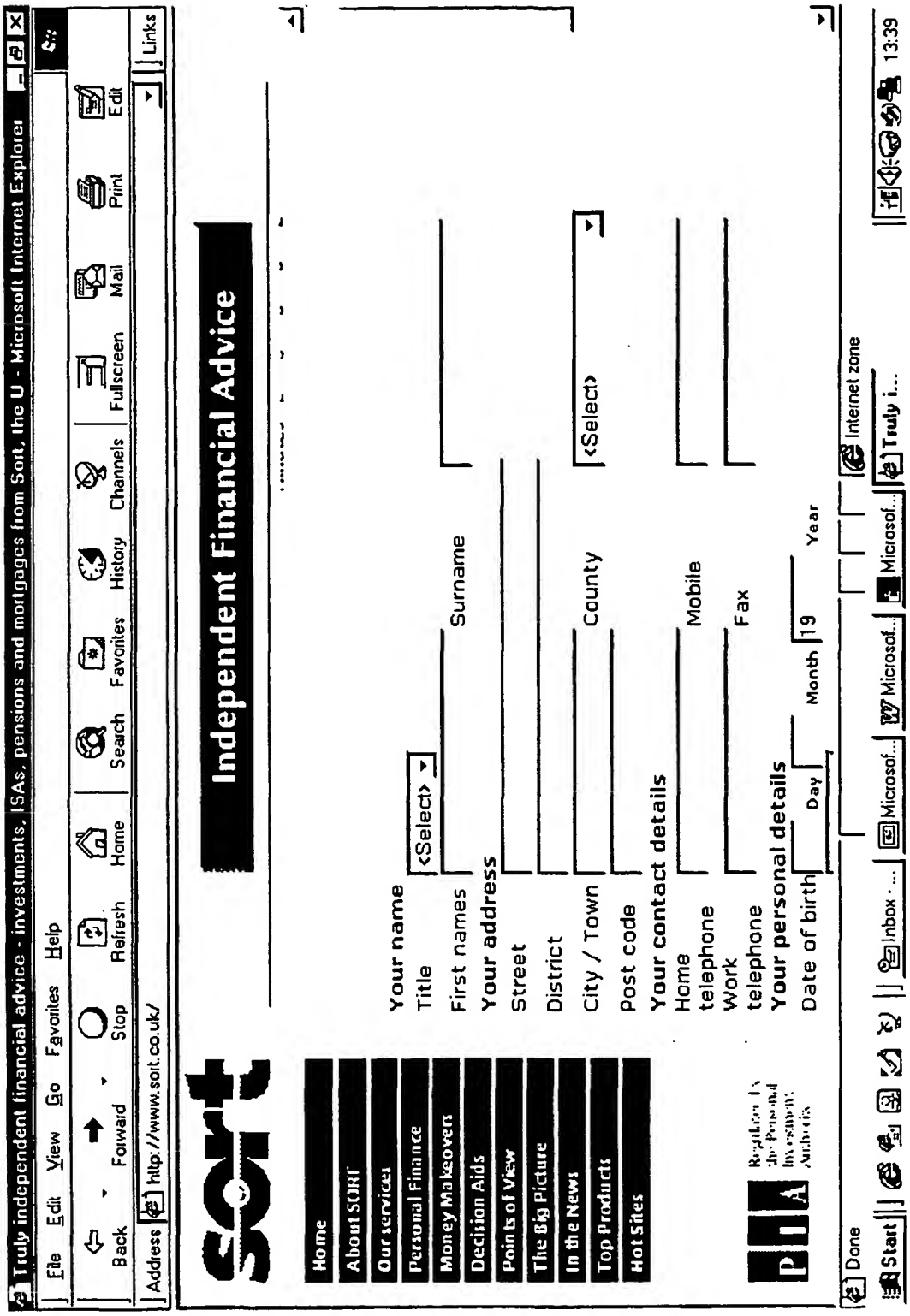
Fig. 6


Truly independent financial advice - investments, ISAs, pensions and mortgages from Sort, the U - Microsoft Internet Explorer
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Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://www.sort.co.uk/
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Independent Financial Advice
Home
About SORT
Our services
Personal Finance
Money Makeover
Decision Aids
Points of View
The Big Picture
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County
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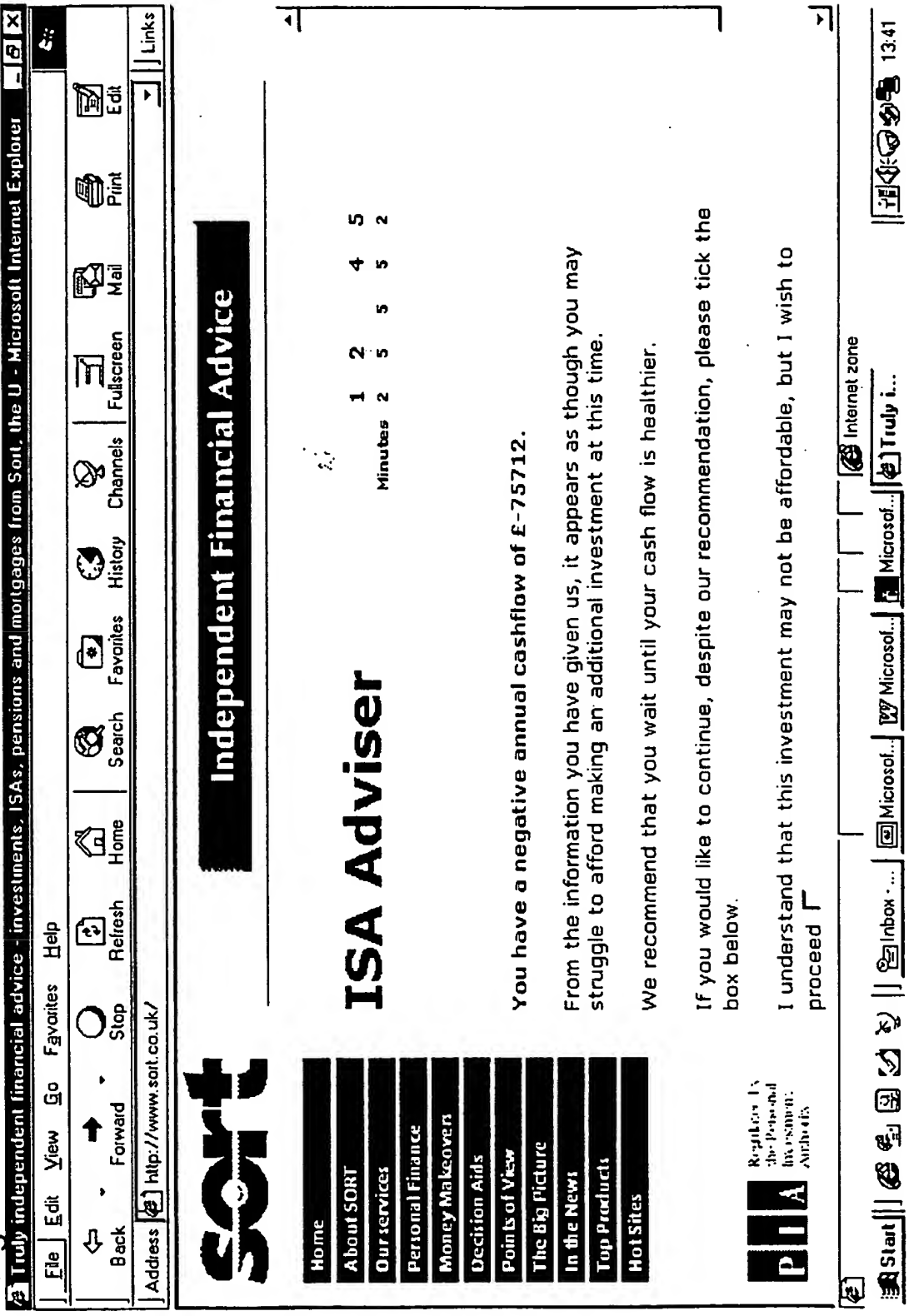
Fig. 7


Truly independent financial advice - investments, ISAs, pensions and mortgages from Sort, the U - Microsoft Internet Explorer
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Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://www.sort.co.uk/
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Independent Financial Advice
Home
About SORT
Our services
Personal Finance
Money Makeovers
Decision Aids
Points of View
The Big Picture
In the News
Top Products
Hot Sites
ISA Adviser
Minutes 1 2 4 5
2 5 5 5 2
You have a negative annual cashflow of £-75712.
From the information you have given us, it appears as though you may struggle to afford making an additional investment at this time.
We recommend that you wait until your cash flow is healthier.
If you would like to continue, despite our recommendation, please tick the box below.
I understand that this investment may not be affordable, but I wish to proceed
Start
Inbox -...
Microsof...
Microsof...
Microsof...
Internet zone
Truly i...
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Fig. 8

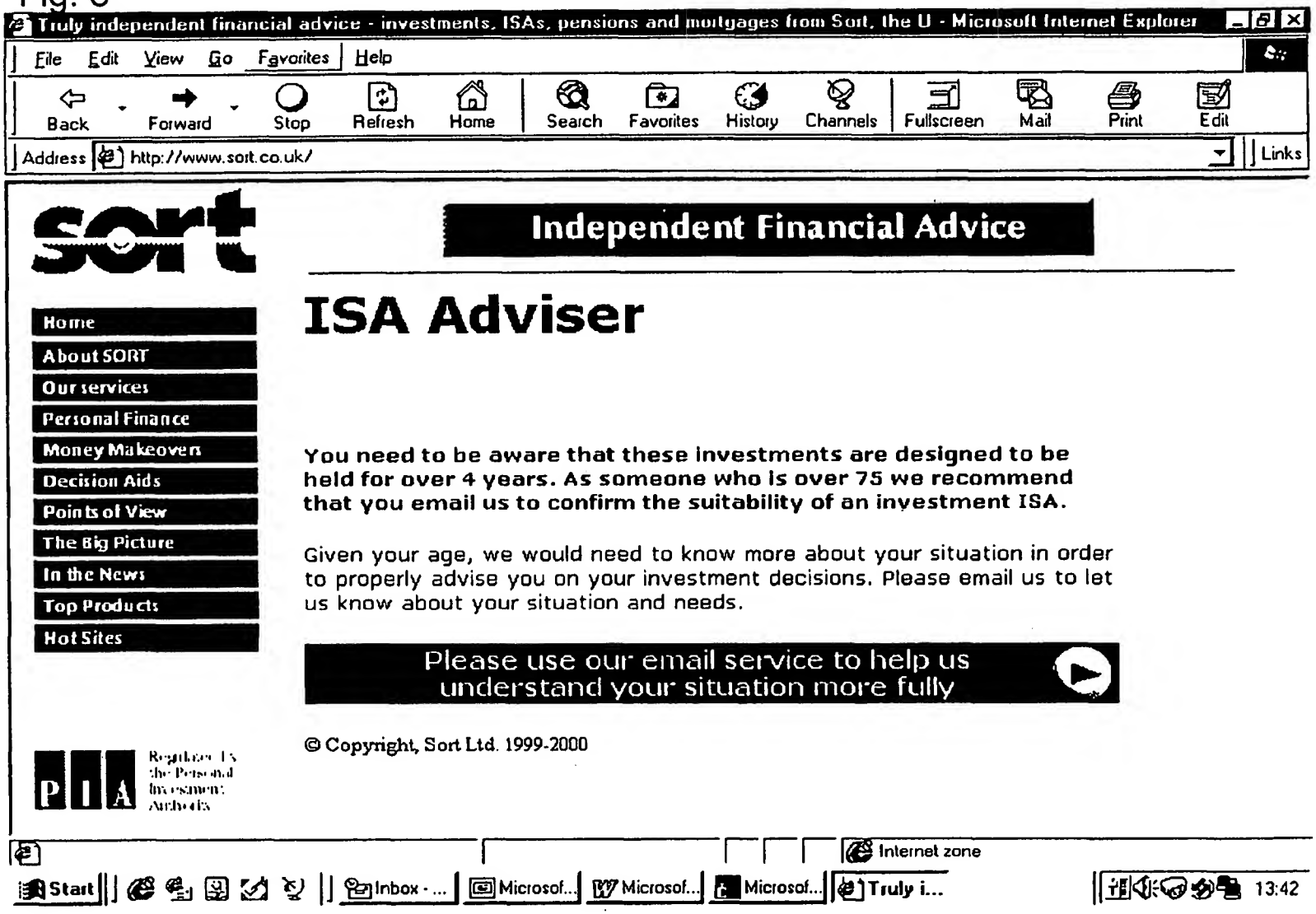

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Fig. 9

Returns sought / Agreed risk tolerance	Better than Building society	Stock market average	Better than market average	Speculative
No risk saver	No product set available	No product set available	No product set available	No product set available
Safety first investor	No product set available	No product set available	No product set available	No product set available
Careful investor	Product set 1	Product set 2	Product set 2	No product set available
Interested risk taker	Product set 1	Product set 2	Product set 3	Product set 4
Gambler	Product set 1	Product set 2	Product set 3	Product set 4

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Fig. 10

Variable	Example of rule
Date of Birth	Must be between [today's date – 18 years] and [today's date – 80 years] If <18 then 'You need to be 18 years old or over to own an ISA. To find out more about suitable investments for you as someone who is younger than 18, please email us' If >=75 then 'You need to be aware that these investments are designed to be held for 4 years or more, so please ensure that you feel happy with this time frame. If you are looking for a shorter term investment please email us'
Employment	If unemployed then 'As someone who is unemployed, we strongly recommend that you keep your money in cash for the time being until you have found a new job, source of income. ISAs are long term investments and you may need your money in the short term to meet bills etc.' If [within 5 years of taking a pension] and [self-employed] then 'Although we will not advise you as part of this service about other areas of your finances, given your proximity to retirement you need to ensure that your pension provision is sorted out as this may provide greater tax advantages for you.'
Total Expenditure	If [annual income after tax]=<[expenditure] then 'From the information you have given us it appears as though you may struggle to afford making an additional investment at this time. We recommend that you wait until your cash flow is healthier'

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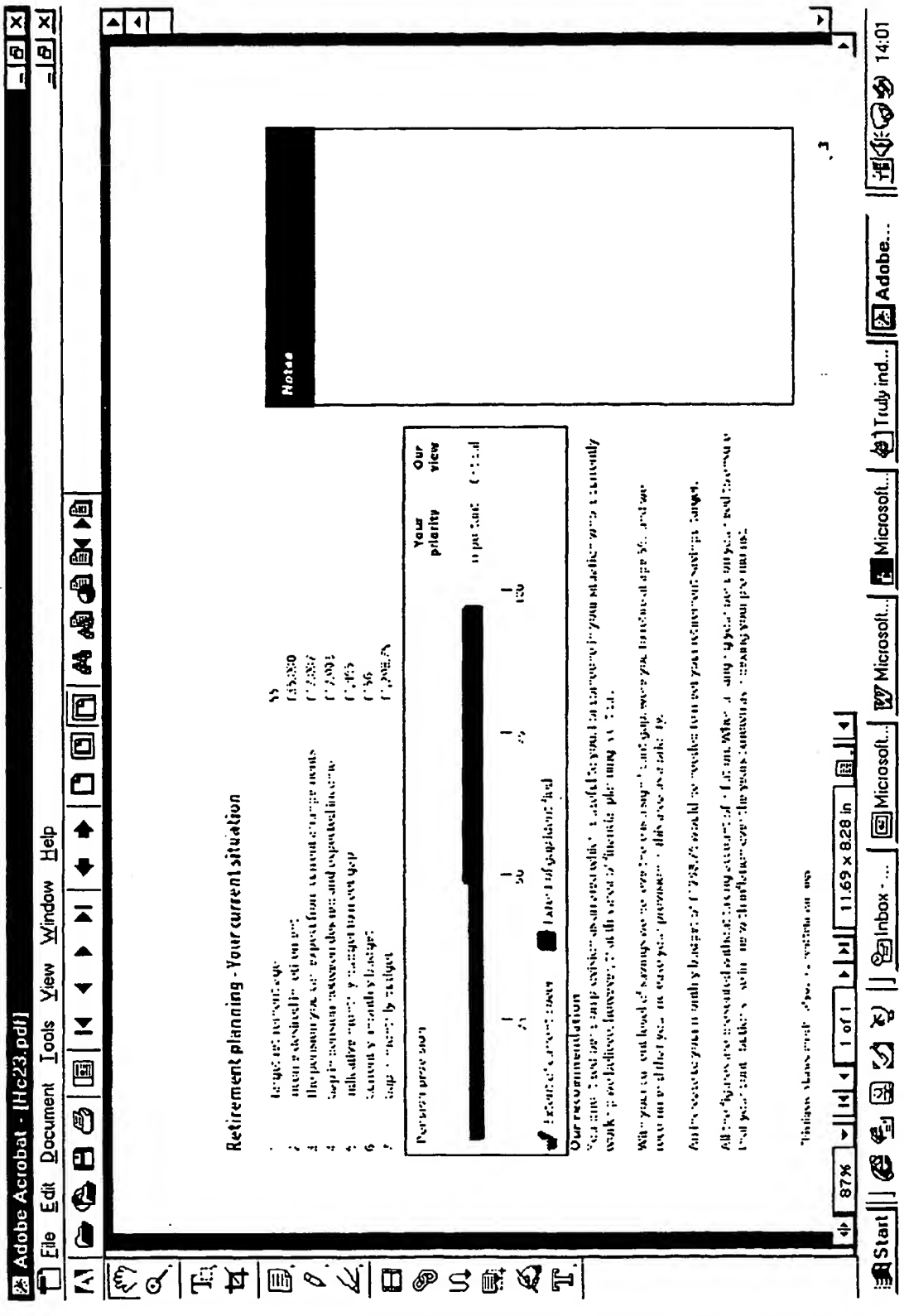
Fig. 11


Adobe Acrobat - [Hc23.pdf]
File Edit Document Tools View Window Help
Retirement planning - Your current situation
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Microsoft...
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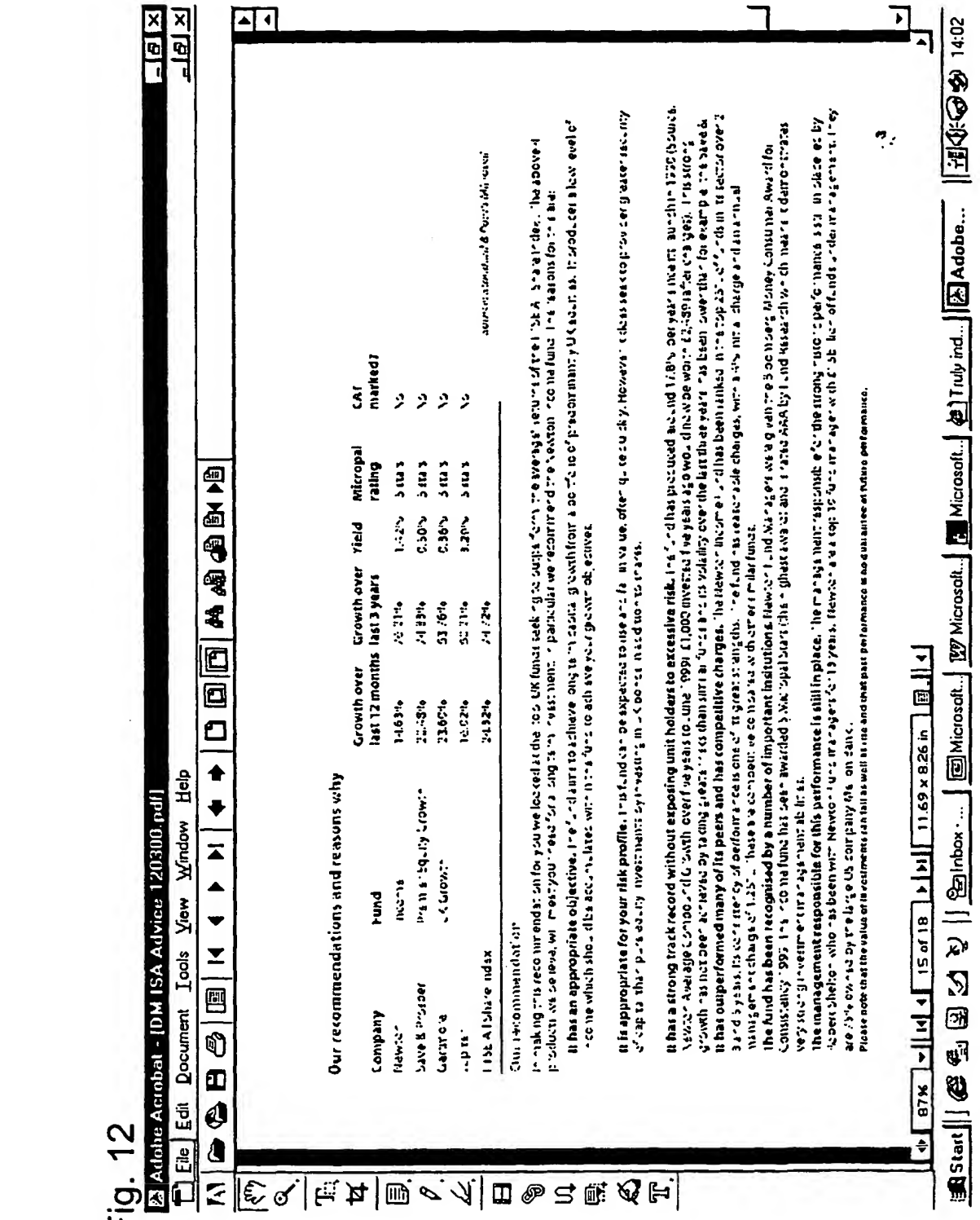
Fig. 12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CAT marketed
Start
Inbox - ...
Microsoft...
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European Patent Office

DECLARATION

which under Rule 45 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number EP 01 30 2249

The Search Division considers that the present application, does not comply with the provisions of the EPC to such an extent that it is not possible to carry out a meaningful search into the state of the art on the basis of all claims

Reason:

The subject-matter claimed in claims 1-28 (the method claims) falls under the provisions of Article 52(2) and (3) EPC, such subject-matter relating to a method of doing business as such.

Claims 31-35 and 28-29 relate to commonplace technological features for performing the business method of the method claims. Although these claims do not literally belong to the method category, they essentially claim protection for the same commercial effect as the method claims. With reference to the Guidelines, C-VIII, points 1-6, the Search Division considers that searching such commercial features, would serve no useful purpose. This applies to the remaining commonplace technological features of these claims as well.

The applicant's attention is drawn to the fact that a search may be carried out during examination following a declaration of no search under Rule 45 EPC, should the problems which led to the declaration being issued be overcome (see EPC Guideline C-VI, 8.5).

CLASSIFICATION OF THE APPLICATION (Int.Cl.7)

G06F17/60

Place of search	Date	Examiner
THE HAGUE	7 August 2001	Skulikaris, I

EPO FORM 1504 (P04C37)